CIVIL ENGINEERING

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AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Among Our Writers

A. P. Greensfelder's life-long interest has been construction and related fields. For many years he has been with the Fruin-Colnon Contracting Co., from 1927 to 1940 as president and since then as chairman. He was formerly chairman of ASCE's Construction Division and established its Construction Engineering Prize.

C. W. Harris (U. of Wash. '08; Cornell U., C.E. '09) has been in charge of technical hydraulics and hydraulic engineering at the U. of Washington from 1907 to date, and designed its hydraulic laboratory. He is now engineering consultant for the International Pacific Salmon Fisheries Commission.

Ernest W. Whitlock (Worcester Poly. Inst.) spent 2 years in France on construction work in World War I and 3 years with Morgan Engineering Co. of Memphis, Tenn. He was with Fuller and McClintock on water and sewerage works 1922–1939. Since then he has been with Malcolm Pirnie Engineers on similar work, becoming a partner in 1946.

Wilson Wyatt, a practicing attorney, served as wartime mayor of Louisville, Ky., from 1941 to 1945, whence he was called to Washington to head the veterans' housing program. He has served as president of the American Society of Planning Officials, and as vice-president and chairman of the American Municipal Association's postwar Planning Committee.

A. H. Candee (Sheffield Scientific School, Yale U. '10), with Westinghouse Electric Corp. since graduation, has had wide experience in the various types of land transportation. He now devotes most of his time in a consulting capacity to railroads considering new forms of motive power.

D. F. Windenburg (Cornell Col., Iowa, A.B. '21, M.A. '23; Catholic U., Ph.D. '30) is now chief physicist, in charge of the Structural Mechanics Div., David Taylor Model Basin, Bur. of Ships, Washington, D.C. Committees on which he serves include ASME Special Research Committee on Vessels Under External Pressure.

Francis R. MacLeay (Northeastern U.) was a consulting engineer, in partnership with George E. Strehan from 1927 to 1940, a practice that included the structural design of buildings as well as the development of building products. For the past 6 years he has been chief engineer, Corbetta Construction Co.

H. H. Houk (U. of Kans., B.S. in C.E. '12) was chief engr. of the Ala. Highway Dept.; then CAA engr. on the Washington National Airport and the War Dept. emergency program until he entered active duty in 1941. As Captain (CEC), USNR, he was Public Works Officer of the Solomons. He is now in general consulting practice.

A. J. Fischer (U. of Pa., B.S. '24); Rutgers U., M.S. '26, Ph.D. '28) received the Kenneth Allen Award of the N.Y. Sewage Works Assn. in 1938 for the best technical paper on sewage research. He has been granted 26 U.S. patents relating to sanitation. Since 1928 he has been Sanitary Development Engr., The Dorr Co., New York.

A. B. Pickett established the general contracting firm of McGregor and Pickett in 1926, and in 1935 organized and served as president of the Arkansas Bauxite Corp. In 1942 he entered the Corps of Engineers as a major. He has been stationed at the U.S. Engineer Office in New Orleans except for a short period at Vicksburg.

George E. Barnes (M.I.T., B.S. in C.E. '23) for 13 years has been head of the Civil Engineering Dept. at Case School of Applied Science, and consultant to many industries and governmental agencies on projects for flood control, water supply, and trade-waste and sewage treatment.

M. W. Kyler has lived on the banks of the "ol' Wiscons" for 41 of the 48 years of his life. The past 22 years he has spent in the active management of this stream, the chief river of Wisconsin.

Charles M. Noble (Columbia U.) was engr. with the Port of N.Y. Authority 1925–1938; special highway engr. on the Pennsylvania Turnpike; and highway engr. on the Pentagon Bldg. A veteran of both World Wars, in the second he was Commander, Civil Engr. Corps, USNR, receiving the Legion of Merit and Bronze Star.

Volume 16 Number 10

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Volume 16 October 1946 Number 10

Balanced Program to Mark Kansas City Meeting, October 16-18

The following program of the Fall Meeting to be held in Kansas City, Mo., October 16–18, is of broad interest to engineers in the Mid-Continent area of the country. In addition to the General Meeting to be held on Wednesday forenoon, October 16, eight of the Society's Technical Divisions will hold sessions on Wednesday afternoon and all day Thursday, October 17.

One of the features of the meeting will be the first session of the newly organized Air Transport Division. Also of special importance to the meeting region are sanitation, water supply, waterways and the economic use of ground water, all of which are covered in the Division sessions.

In addition to the technical features of the meeting, social gatherings, entertainment for visiting ladies and a variety of inspection trips, both scenic and to points of engineering interest, have been arranged by the Local Committee headed by R. N. Bergendoff as chairman.

Preceding the Fall Meeting, there will be meetings of the Board of Direction and a conference of Local Section delegates on Monday and Tuesday, October 14 and 15.

Another feature of the Fall Meeting will be a Student Conference on Thursday, October 17. It is expected that some 40 or more colleges in the midcontinent area will be represented at this conference with a student attendance of approximately 200 anticipated. A special committee in Kansas City is arranging housing for the students.

In Kansas City, Mo.—Jackson County Court House, Left, and Kansas City's City Hall, Right

Fall Meeting in Kansas City, Mo.

Hotel Continental to Be Headquarters, October 16-18, 1946
Program of Meetings, Entertainment and Trips

General Meeting—Wednesday Morning

9:00 **Registration**

CONTINENTAL ROOM

10:00 **Meeting Called to Order by:**
JOHN C. LONG, Assoc. M. ASCE, President, Kansas City Section, American Society of Civil Engineers

10:10 **Address of Welcome**
HON. WILLIAM E. KEMP, Mayor of Kansas City

10:25 **Response:**
W. W. HORNER, President, American Society of Civil Engineers

10:40 **The Engineer and the Changing Social Order**
H. S. AURAND, Major General, USA, Director, Research and Development Division, War Department General Staff, Washington, D.C.

11:20 **"Kansas City, USA"**—in color and sound motion pictures

11:50 **Recess for Luncheon**

12:30 **Luncheon—Members and Guests—Hotel President—Kansas City Engineers Club as hosts**
Address "Personal Engineering"
DR. HEROLD C. HUNT, Superintendent of Kansas City Public Schools
Tickets for the Luncheon are $1.25 each.

Ladies Luncheon and Entertainment Wednesday Afternoon

At the close of the morning session the ladies will assemble on the Sky Hi Roof of the Hotel Continental for Luncheon.

Following the luncheon and a social hour the ladies will have opportunity to visit various points of interest in Kansas City. Transportation will be provided.

Tickets for the luncheon are $1.50 each. No charge for transportation.

PARK SCENES IN KANSAS CITY, MO.

Dinner, Entertainment and Dance—Wednesday Evening

7:00 **Dinner, Continental Room**
Address: "The Outlook for World Peace," by DR. DONALD J. COWLING, Mayo Foundation, University of Minnesota
Presiding: JOHN G. LONG, President of Kansas City Section, American Society of Civil Engineers, will be master of ceremonies at the dinner.

10:00 **Dancing, Green Room**
Tickets for the Dinner and evening's entertainment are $4.50 each.
Students will be admitted free for dancing upon presentation of Student cards.

COUNTRY CLUB PLAZA DISTRICT, LOOKING SOUTHWEST, KANSAS CITY, MO.

Technical Division Sessions—Wednesday Afternoon

Air Transport Division

Alfred J. Ryan, Chairman, Executive Committee, Air Transport Division, Presiding

2:00 **Airport Planning for Scheduled Airline Operation**

E. H. SITTNER, Director of Functional Engineering, Transcontinental and Western Air, Inc., Kansas City, Mo.

Discussion

2:45 **Utility of the California Bearing Ratio Method of Design**

W. J. TURNBULL, M. ASCE, Chief Soils Division, U.S. Waterways Experiment Station, Vicksburg, Miss.

Discussion

3:30 **Design of Flexible Pavements for Multiple Wheel Loads**

CHARLES R. FOSTER, Jun. ASCE, Asst. Chief, Flexible Pavements Branch, U.S. Waterways Experiment Station, Vicksburg, Miss.

4:00 **Discussion**

Highway Division

Day Okes, Chairman, Executive Committee, Highway Division, Presiding

2:00 **Express Highways as Related to Parking**

GEORGE M. SHEPARD, M. ASCE, Chief Engineer, Dept. of Public Works, St. Paul, Minn.

2:30 **Discussion**

3:00 **Expansion-Joint Practice in Highway Construction**

A. A. ANDERSON, Assoc. M. ASCE, Manager, Highways and Municipal Bureau, Portland Cement Association, Chicago, Ill.

3:30 **Discussion opened by**

CHARLES H. SCHOLER, M. ASCE, Professor of Applied Mechanics, Kansas State College of Agriculture and Applied Science, Manhattan, Kans.

Sanitary Engineering Division

George J. Schroepfer, Chairman, Executive Committee, Sanitary Engineering Division, Presiding

2:00 **Sanitary Engineering Aspects of the Missouri Valley Development**

EARNEST BOYCE, M. ASCE, Professor of Municipal and Sanitary Engineering, University of Michigan, Ann Arbor.

2:00 **As it affects:**

Missouri	W. SCOTT JOHNSON, M. ASCE, Chief Public Health Engineer, Missouri State Board of Health, Jefferson City, Mo.
Kansas	PAUL D. HANEY, Assoc. M. ASCE, Chief Engineer, Division of Sanitation, Kansas State Board of Health, Lawrence, Kans.
Iowa	BEN L. WILLIAMSON, Assistant Engineer, State Dept. of Health, Des Moines, Iowa
Montana	H. B. FOOTE, Director, Division of Sanitary Engineering, State Board of Health, Helena, Mont.
South Dakota	W. W. TOWNE, Director, Division of Sanitary Engineering, State Board of Health, Pierre, S.Dak.
North Dakota	JEROME H. SVORE, Senior Sanitary Engineer, State Dept. of Health, Bismarck, N.Dak.
Wyoming	L. O. WILLIAMS, JR., State Sanitary Engineer, State Dept. of Health, Cheyenne, Wyo.

3:30 **Water Supply Problems of Kansas City**

MELVIN P. HATCHER, Assoc. M. ASCE, Director, Water Department, Kansas City

3:55 **Water Works Problems of the City of St. Louis**

JOHN B. DEAN, M. ASCE, Division Engineer, Supply and Purifying Section, Water Division, St. Louis

4:20 **General Discussion**

Sessions of Technical Divisions—Thursday Morning

Structural Division

Arthur J. Boase, Member, Executive Committee, Structural Division, Presiding

9:00 **Air Entraining of Cement**

CHARLES E. WUERPEL, U.S. Waterways Experiment Station, Vicksburg, Miss.

9:30 **Discussion**

10:00 **Unusual Design Features of the Harlan County Dam**

L. G. FIEL, Engineer, U.S. Engineer Department, Kansas City, Mo.

10:30 **Fort Randall Reservoir Project**

WENDELL E. JOHNSON, Assoc. M. ASCE, Engineer, U. S. District Engineer Office, Omaha, Nebr.

11:00 **General discussion**

City Planning Division

Frank H. Malley, Member, Executive Committee, City Planning Division, Presiding

9:00 **Panel Discussion on "What can be done to anchor downtown city business properties and check the movement of residential properties beyond city boundaries?"**

Moderator

L. P. COOKINGHAM, City Manager of Kansas City, Kansas City, Mo.

Statement of Problem

JOHN M. PICTON, M. ASCE, Chief Planning Engineer, City Planning Commission, Kansas City, Mo.

The City Planner's Contribution

RUSSELL H. RILEY, Harland Bartholomew and Associates, St. Louis, Mo.

The County Planner's Contribution

HUGH R. POMEROY, Director, Westchester County Park Commission, White Plains, N.Y.

The State Official's Contribution

LEONARD A. BERGMAN, Director, Bureau of Planning, New York State Department of Commerce, Albany, N.Y.

The Regional and Federal Official's Contribution

EARLE S. DRAPER, Planning Consultant, Federal Housing Administration, Washington, D.C.

The Federal Government's Contribution

WILSON W. WYATT, Administrator, National Housing Agency, and Expediter, Veterans Emergency Housing Program, Washington, D.C.

The Local Developer's Contribution

T. T. MCCROSKY, M. ASCE, Executive Director, Greater Boston Development Committee, Inc., Boston, Mass.

Waterways Division

Col. C. L. Hall, Chairman, Executive Committee, Waterways Division, Presiding

9:00 **Considerations Determining Whether Navigation Is to Be Attained by Open-Channel Methods or by Locks and Dams**

MALCOLM ELLIOTT, M. ASCE, Col., Corps of Engineers, USA, Division Engineer, Upper Mississippi River Valley Division, St. Louis, Mo.

9:20 **Discharge and Sediment Relationship in a River**

LORENZ G. STRAUB, M. ASCE, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis, Minn.

9:40 **Alinement as It Affects Open-Channel Methods**

JOSEPH F. FRIEDKIN, Assoc. M. ASCE, Captain, Corps of Engineers, USA, U.S. Waterways Experiment Station, Vicksburg, Miss.

10:00 **Soil Characteristics of Bed and Banks as They Affect Open-Channel Methods of Improvement**

CHARLES SENOUR, M. ASCE, Head Engineer, Mississippi River Commission, Vicksburg, Miss.

10:20 **Contraction Works**

DELBERT B. FREEMAN, M. ASCE, Lt. Col., Corps of Engineers USA, U.S. Engineers Office, Omaha, Nebr.

10:40 **Dredging**

LAWRENCE B. FEAGIN, M. ASCE, Col., Corps of Engineers, USA, District Engineer, U.S. Engineer Dept., St. Louis, Mo.

11:00 **Discussion**

Sessions of Technical Divisions—Thursday Afternoon

Engineering Economics Division

Jonathan E. Teal, Chairman, Executive Committee, Engineering Economics Division, Presiding

2:00 **Industrial Use of Ground Water**

William F. Guyton, Jun. ASCE, Hydraulic Engineer, Ground Water Division, U.S. Geological Survey, Louisville, Ky.

2:30 **Quality of Water**

W. D. Collins, Chief of the Division of Quality of Water, Water Resources Branch, U.S. Geological Survey, Washington, D.C.

3:00 **Use of Ground Water in Agriculture**

George S. Knapp, M. ASCE, Chief Engineer, Division of Water Resources of Kansas, Topeka, Kans.

3:30 **Need for Legislation and Control of Underground Water**

L. A. Smith, M. ASCE, Superintendent, Water Department, City of Madison, Wis.

4:00 **General discussion**

Surveying and Mapping Division

Philip Kissam, Chairman, Executive Committee, Surveying and Mapping Division, Presiding

2:00 **The Technical Aspects of Military Mapping at the Army Map Service**

Albert L. Nowicki, Topographic Engineer, Operations and Planning Staff, Army Map Service, Washington, D.C.

2:30 **Discussion opened by**

Daniel Kennedy, Assoc. M. ASCE, Chief, Operations and Planning Division, Army Map Service, Washington, D.C.

3:00 **Surveys and Maps in Subdivision Planning**

Richard Y. Jones, Civil Engineer, Neosho, Mo.

3:30 **Discussion opened by**

R. E. Riddle, Sr., Consulting Engineer, St. Joseph, Mo.

William M. Spann, M. ASCE, Consulting Engineer, Kansas City, Mo.

4:00 **General discussion**

Entertainment Features for Thursday

Entertainment for Ladies—Thursday Afternoon

12:30 **Ladies Luncheon at the Brookside Hotel, with entertainment, including a book review, by Rev. Herbert H. Duenow**

Following the luncheon, the ladies will have a conducted tour through Kansas City's beautiful residential district. Kansas City is noted for its homes, boulevards, parks, and gardens.

Tickets for the luncheon, afternoon's entertainment, and transportation are $1.50 each.

Inspection Trips—Thursday Afternoon

Arrangements have been made for visits to the Kansas City Airport, Kansas City Water Works, and the new Missouri River lift bridge.

No charge for tickets.

Dinner and Entertainment—Thursday Evening

Continental Room

7:00 **Dinner and Social Evening at Hotel Continental**

Dinner, music, and entertainment will make this function a highlight of the meeting.

Tickets $4.00 each.

All-Day Excursion on Friday

A tour of the city by buses will be made on Friday, leaving the Hotel Continental at 10 a.m. Luncheon will be served at a convenient place en route.

Interesting sights to be seen on the drive will include: City Auditorium; Union Station; Liberty Memorial; City Hall Court House; beautiful Country Club residential district; Nelson Museum of Art; University of Kansas City; Swope Park; Clarks Point, from which a broad view can be had of the Missouri and Caw rivers, and the airfield of both Kansas Cities; bridges over the Missouri River; the large Sheffield Steel Plant; the Cliff Drive along the Missouri River; sections of the business district; and other outstanding places of interest.

The buses will stop at several places en route and guides will describe or announce the important places or scenes.

The party will return to the Hotel Continental in mid-afternoon.

Tickets, $1.75 for transportation.

Request hotel reservations as far in advance of the meeting as possible.
Also aid the committee by registering early.

Announcements

Hotel Accommodations

The Hotel Continental will be Fall Meeting Headquarters. It is anticipated that a large number of the visitors will have to be accommodated at nearby hotels. A list of available hotels and their rates are listed below, together with a form for requesting hotel reservations. Mail this form early, indicating first, second, and third choice. Whenever possible, arrangements should be made for occupancy of rooms accommodating two or more persons. All reservations are to be cleared through the Housing Bureau.

Schedule of Rates

Hotel	For One Person	For Two Persons: Double Bed	For Two Persons: Twin Beds
Aladdin	$2.00 to $3.00	$3.00 to $5.00	$4.00 to $6.00
*Ambassador	1.50 to 2.50	2.50 to 3.50	5.00 or 6.00
*Bellerive	3.00 to 5.00	4.50 to 6.00	5.00 to 7.00
Bray	1.50 to 3.00	2.50 to 4.00	4.00 to 6.00
Commonwealth	2.00 to 3.00	3.00 to 5.00	4.00 to 6.00
Continental	2.50 to 4.00	4.00 to 5.00	4.00 to 7.00
Dixon	2.00 to 3.50	3.00 to 4.00	4.00 to 6.00
Fredric	1.50	2.00 to 2.50	
Howard	3.00	4.00	
*La Salle	2.00 to 6.00	3.00 to 8.00	
Muehlebach	3.25 to 7.00	4.50 to 8.00	5.00 to 9.00
Phillips	2.50 to 5.00	4.00 to 8.00	5.00 to 8.00
Pickwick	2.50 to 4.00	3.50 to 6.00	4.00 to 7.00
President	2.50 to 5.00	4.00 to 6.50	5.00 to 7.00
Robert E. Lee	2.00 to 3.00	3.00 to 5.00	4.00 to 6.00
Sexton	1.50 to 2.50	3.00 to 4.00	4.00 to 5.00
State	2.50 to 3.50	3.00 to 5.00	5.00 to 6.00

* Indicates outlying hotels

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Mark C. Culbreath, Chairman Housing Bureau, American Society of Civil Engineers
1030 Baltimore Avenue, 3rd floor, Kansas City 6, Missouri

Please reserve the following accommodations for the Kansas City Meeting October 12–18, 1946:

Single Room—— Room with Double Bed—— Room with Twin Beds——

Rate Preferred: From $—— to $—— First Choice Hotel ——————
Second Choice Hotel——————
Third Choice Hotel——————
Number in party—————— Fourth Choice Hotel——————

Arrival Date, Oct.—— Time——(a.m.) (p.m.) Departure Date——————

Names and addresses of all persons for whom you are requesting reservations. The name of each hotel guest must be listed:

Name—————————— Address——————————
Name—————————— Address——————————
Name—————————— Address——————————

If the hotels of your choice are unable to accept your reservation the Housing Bureau will make as good a reservation as possible elsewhere.

(Signed) ——————————————————
(Street Add.) ——————————————————
(City and State) ——————————————————

Information

An Information Desk will be provided in the Headquarters Hotel to assist visiting members in obtaining desired information about the city. Any mail for members received at Headquarters during the Fall Meeting will be delivered to the hotel address, if known; otherwise it will be held at the Information Desk. Letters undelivered at the close of the Fall Meeting will be forwarded.

Local Sections Conference, Monday and Tuesday, October 14 and 15

A conference of representatives of Local Sections will be held at 10:00 a.m., on Monday and Tuesday, October 14 and 15, 1946, at the Hotel Continental. The program will schedule topics of professional rather than technical interest, in which all representatives are expected to participate. All members of the Society are welcome to attend.

Student Conference and Luncheon, Thursday, October 17

A Student Conference will be held on Thursday forenoon, followed by a Luncheon of Student Chapter delegates and special sightseeing trips for Students on Thursday afternoon. Members of Student Chapters are invited to participate in all events of the Fall Meeting.

Local Committees

EXECUTIVE

R. N. Bergendoff, General Chairman
John C. Long, President, Kansas City Section
Samuel J. Callahan, Vice-President, Kansas City Section
Ansel N. Mitchell, Vice-President, Kansas City Section
Josef Sorkin, Secretary-Treasurer, Kansas City Section
Melvin Hatcher, Director, Kansas City Section
E. B. Black, Chairman, Program Committee
Joseph W. Ivy, Chairman, Publicity Committee
Mark C. Culbreath, Chairman, Reservation-Registration Committee
C. A. Haskins, Chairman, Finance Committee
O. W. Anschuetz, Chairman, Reception Committee
T. J. Seburn, Chairman, Transportation Committee
E. Kemper Carter, Chairman, Entertainment Committee
James D. Marshall, Chairman, Student Activities
Mrs. A. N. Mitchell, Chairman, Ladies Committee

PROGRAM

E. B. Black, Chairman; Ernest E. Howard, Vice-Chairman; E. L. Filby, D. H. McCoskey, W. L. Patterson, J. M. Picton, W. M. Spann.

RESERVATION-REGISTRATION

Mark C. Culbreath, Chairman; A. T. Cushing, Vice-Chairman; H. H. Benjes, D. M. Dodds, E. A. Elliott, F. L. Geis, P. C. Hammelef, C. S. Harper, W. E. Wilbur, E. Wilkes.

RECEPTION

O. W. Anschuetz, Chairman; Bert F. Stevens, Vice-Chairman; G. Acree, E. A. Vlanpied, T. J. Cambern, F. M. Cortelyou, R. B. Houston, R. McKinley, E. I. Myers, J. V. Oliver, A. F. Sachs, A. B. Taylor, Richard Tipton.

TRANSPORTATION

G. H. Frieling, Chairman; T. J. Seburn, Vice-Chairman; D. L. Blackwell, H. M. Brush, A. T. Everham, H. H. Fox, R. L. Hahn, R. S. Patterson, J. B. Ramsey, W. J. Ware.

STUDENT ACTIVITIES

J. D. Marshall, Chairman; L. E. Nelson, Vice-Chairman; Donald Flanders, D. E. Harper, D. W. Lemon, C. K. Mathews, Jasper Meals, W. G. Riddle, R. J. Spiegel.

PUBLICITY

Joseph W. Ivy, Chairman; O. P. Allee, Vice-Chairman; G. C. Brewster, Carl L. Erb, K. K. King.

FINANCE

Chas. A. Haskins, Chairman; Chester Smith, Vice-Chairman; E. W. Bacharach, J. Q. A. Greene, Gordon Hamilton, Earl W. Homan, Henry Massman, Jr., A. L. Mullergren, Arthur N. Reece, Thos. D. Samuel, Jr., T. J. Strickler.

ENTERTAINMENT

E. Kemper Carter, Chairman; R. P. Woods, Vice-Chairman; H. S. Allen, H. Darby, J. Q. A. Greene, Gordon Hamilton, Kirk McFarland, John E. Maring, Henry Massman, Jr., A. L. Mullergren, T. J. Strickler, Clare R. Van Orman.

LADIES

Mrs. Ansel N. Mitchell, Chairman
Mrs. Melvin P. Hatcher, Vice-Chairman

Mrs. O. W. Anschuetz
Mrs. Eric Bacharach
Mrs. Alfred Barnes
Mrs. H. H. Benjes
Mrs. R. N. Bergendoff
Mrs. E. B. Black
Mrs. George C. Brewster
Mrs. J. F. Brown
Mrs. Robert L. Brown
Mrs. Fred Bruun
Mrs. S. J. Callahan
Mrs. T. J. Cambern
Mrs. E. K. Carter
Mrs. Frank Cortelyou, Jr.
Mrs. Mark Culbreath
Mrs. D. M. Dodds
Mrs. Carl Erb
Mrs. Iver Erickson
Mrs. Arthur C. Everham
Mrs. E. A. Farmer
Mrs. E. L. Filby
Mrs. Gerald Frieling
Mrs. R. C. Gibson
Mrs. Barclay Greene
Mrs. J. Q. A. Greene
Mrs. C. A. Haskins
Mrs. Earl Homan
Mrs. Ernest E. Howard
Mrs. G. R. Huff
Mrs. J. W. Ivy
Mrs. Clifford B. Kimberly
Mrs. R. G. Kincaid
Mrs. K. K. King
Mrs. A. P. Learned
Mrs. John C. Long
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Mrs. Kirk McFarland
Mrs. Reed McKinley
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Mrs. Otto Reynolds
Mrs. T. J. Seburn
Mrs. Chester Smith
Mrs. Josef Sorkin
Mrs. W. M. Spann
Mrs. Bert Steves
Mrs. John Strang
Mrs. T. J. Strickler
Mrs. Ashley B. Taylor
Mrs. Earl Thomson
Mrs. C. R. Van Orman
Mrs. N. T. Veatch
Mrs. Edmund Wilkes, Jr.

Engineers, Contractors Urged to Assume Construction Leadership

By A. P. Greensfelder, M. ASCE

Chairman, Fruin-Colnon Contracting Company, St. Louis, Mo.; Honorary Chairman, Consulting Constructors Council of America

Significance of the enthusiastic interest engineers and constructors have in the economics of the wealth they create has been demonstrated time and time again. To increase the leverage of such opinion, Mr. Greensfelder suggests in this article the formation of an institute for the study of construction economics. He speaks from a breadth of experience in construction and of active service in several organizations, including ASCE's Construction Division, of which he is a past chairman.

Construction is not something apart from other American business. The function of the construction industry is to create more comfortable shelters for man, to provide more healthful facilities for his use, to expand his utilities, and to enlarge the national wealth for his ever-increasing benefit. To date the industry has never failed so to function that the forward march of civilization has been coincident with increasing construction volume. Thus, it is high time that we engineers and constructors should convince the leaders of all American industries of their dependence upon construction. We must merchandise construction.

It would seem plainly evident that engineering and construction projects must all have a sound economic basis. It will no longer suffice for each branch of engineering or field of construction to plead special consideration and apply for finances without regard to every other. Since we have spread industry nationwide with steel, rubber, chemical, and airplane plants, we must needs develop a unified production and distribution program which will adequately feed, clothe, and house all our people. Plowing under crops, wasting natural resources, and minimizing productive employment are not economic solutions to American progress.

This sums up to the fact that we sorely need a Construction Economics Institute in order to evolve an economic development for the construction industry in step with the even higher standards of civilization which construction currently symbolizes. We must minimize seasonal and cyclical unemployment. It therefore behooves us to develop such an institute properly and promptly. This does not imply another large association with a great staff. It does mean that construction engineers should take the leadership in instituting an economic program that will evolve sound construction practices without booms, or the boomerangs which follow them. This should particularly interest the Construction and Economics Divisions of our Society.

As examples outlining the broad field of service which such an organization could enter, it takes but a moment to point out needs in currently divided endeavors. Perhaps first in terms of present emphasis is housing.

Today as never before throughout the world, as a result of World War II, the demand for adequate housing is preeminent. The equity of that demand by our veterans is beyond question. We owe them more than roofs over their heads. We owe them good neighborhoods in good cities. It is lack of foresight that caused the housing shortage and the construction confusion facing us today.

We must interest our insurance companies and other large investors in urban redevelopment projects. Several of the large insurance companies have already undertaken worthy housing programs, but so far it is only in a minor degree. Public housing can have its place for the lowest underprivileged workers, but should not compete with private enterprise. Public housing must delimit its activities to accommodate only those with low-level incomes. It must not become a political puppet or occupants of such houses will depend upon political favoritism.

Housing is more than merely a house. It is dependent upon the horizontal facilities that serve it, including streets, sewers, water, gas, and electrical wiring. Thus to every dollar's worth of building there must be added a certain percentage for such facilities. Community housing, either public or private, should be in modern fireproof structures arranged to provide convenient recreational and educational facilities. Otherwise they can be the slums of the next generation. It will require good engineering analysis, simplified architectural design, and efficient construction to produce housing on a worthy basis. America can afford and must provide safe and sanitary housing for its people. Labor must cooperate in every respect so that its families can enjoy homes. It is a supreme nationwide task of our times, which requires a wise continuing solution, and the interest of our Structural Division.

Transportation Essential

The studies of a Construction Economics Institute should certainly include the extensive transportation systems. Out of many conferences through the years has come a vast network of hard-surfaced highways enabling millions of motor vehicle operators to expand their horizons of activity. Yet symptomatic of the lack of unity of road builders and road users are the interstate "road blocks," which seriously restrict the free flow of commerce over the highways.

Dating from the earliest forms of transportation, by water, and growing more complex as the rails, the roads, and the air lanes fanned out, the problem of coordinating transport has pressed for solution. This is one of the immediate engineering tasks of our transportation experts. It will require elimination of traditional thinking, and the recognition that transport by whatever means is the function and requirement of transportation facilities.

Communication is another vital means of uniting a nation that would bear extensive study. Whether the services are obtained by wire or wireless, all require engineering achievements and constructive genius. The radar and electronic developments of the future are just now being initiated. News teletypes and photo telecasts in our offices, inter-auto and walkie-talkie communications will soon be transferred from the battlefield to peacetime uses. If this appears to be self-evident, give a thought to Europe, where lack of

free communication is synonymous with disunity.

MIGRATION CALLS FOR CONSTRUCTION

The migration of sizable proportions of our population carried with it the need for public facilities, public utilities, and shelter. It also prompts the suggestion that serious effort be given to means of stabilizing population movements. People stay where they are content, and contentment today is based upon convenience and appropriate distribution of neighborhood facilities. This means varied research to assure modern hospital, sanitation, educational, recreational, and commercial facilities which will satisfy the oncoming generations. This field should prove of particular interest to the members of our Sanitary Engineering Division.

All cities in America need "reurbanization." This includes the replanning, replating, rezoning, renovating, and reconstruction of small and large urban areas. It is one of the greatest needs of the Nation. It will take vision, imagination, initiative, and progressive modernizations to maintain urban and metropolitan populations from decentralizing and migrating. These are urgent problems for our City Planning Division.

CONSERVING NATURAL RESOURCES

The conservation of our natural resources is one of the most pertinent and important problems facing the Nation today. For generations we have wantonly wasted the great resources with which our Nation was so richly endowed by Nature. This applies not only to soil and water, but to the wildlife and its habitats as well as to subsurface minerals.

The diminution of soil erosion and dust storms, and the development of new mineral resources, many of which provide construction materials, are important to the engineering and construction fraternity.

Cannot we learn from the older populated lands of Asia how a country becomes denuded through lack of conservation of its natural resources? The remaining natural wealth of our United States must be promptly and properly conserved or we cannot even maintain the standards of living that we now enjoy, much less raise them.

The vast engineering projects required for flood control and irrigation are outstanding examples of such needful projects. The which, where, and when of these dams and waterways should be solved by analyses and not distributed as political plums. The Nation can only afford to finance and maintain conservation programs which are economically justified.

Our water resources need careful examination by our ablest hydraulic engineers to determine the several uses to which they can be put. Power production, flood control, irrigation, recreational or wildlife conservation are all related elements and must be considered in the final planning of the stupendous projects which the Nation has now under way, and will continue to be considered as our present resources diminish. Dams for "little rivers," as the late President Franklin D. Roosevelt designated them, at the head of the watershed branches, and the proper construction of millions of ponds throughout the Nation, may seem small in themselves but will total large if properly planned, constructed, and maintained. These are all problems which our Hydraulic, Irrigation, Power, and Waterways Divisions doubtless are contemplating.

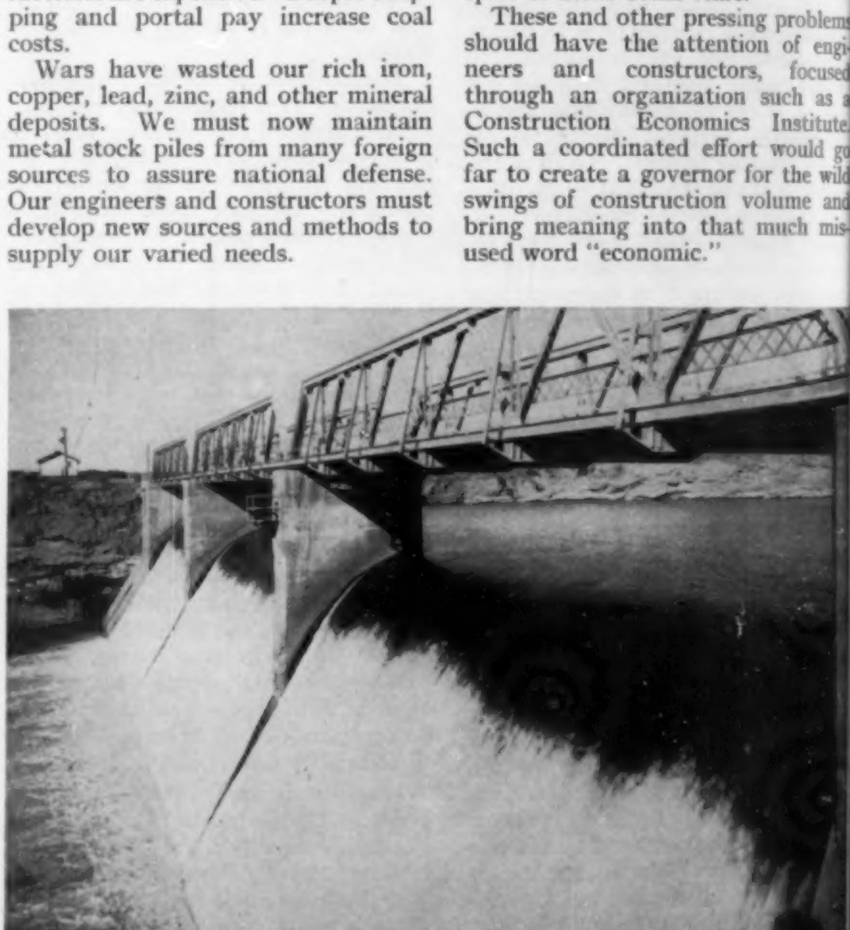
Our gas, liquid and solid fuels are becoming scarcer daily. We now drill three miles for oil, and the "big" and "little" inch pipe-lines from fields to factories are expensive. Deeper stripping and portal pay increase coal costs.

Wars have wasted our rich iron, copper, lead, zinc, and other mineral deposits. We must now maintain metal stock piles from many foreign sources to assure national defense. Our engineers and constructors must develop new sources and methods to supply our varied needs.

Industry learned rapidly during the recent war period how dependent a factory is upon other factories for supplies, parts, and raw materials. War production plants were spread all over the Nation to assure decentralization and labor supply. Just how intelligent our peacetime use of these plants will be is a matter that concerns all of us. We demonstrated to the world that during the war period we had the "know-how" to produce large quantities very rapidly. If we are again given the opportunity to develop private enterprise, there is no question but that we can regain the industrial efficiency and volume for which our Nation has been noted.

America needs industrial production with modern materials and modern designs as never before. It seems unnecessary to zone America into regions in order to provide the manufactured articles where needed. Equalized transportation and production should enable our country to so coordinate its industrial development that the states will remain united economically as well as politically in spite of atom-bomb fears.

These and other pressing problems should have the attention of engineers and constructors, focused through an organization such as a Construction Economics Institute. Such a coordinated effort would go far to create a governor for the wild swings of construction volume and bring meaning into that much misused word "economic."



NATURAL RESOURCES CAN BE CONSERVED, AS GREAT STORAGE DAMS PROVE

Salmon Swim Hell's Gate Through New Fishway

By C. W. Harris, M. ASCE
Consulting Engineer, International Pacific Salmon Fisheries Commission, Seattle, Wash.

A SERIOUS threat to the sockeye salmon fisheries was a natural obstruction in the Fraser River called Hell's Gate Canyon. At certain stages of flow the rapids at this point prevented migration of the fish to spawning grounds upstream. All this was changed by the completion of fishways through the canyon. An unusual feature of these structures described by Professor Harris is the system of baffles which lowers the velocity of the water.

The famous sockeye salmon of the Puget Sound and British Columbia region spawns in or near some lake in which the young can develop for a period of from one to two years. The life span of this salmon is predominantly four years, approximately half of which is spent in salt water. Before returning to fresh water it has stored up an immense supply of energy which it expends in migrating those hundreds of miles back to the lake area of central British Columbia, up one of the most turbulent rivers of the American continent. The mature salmon returns to the same spawning ground in which it was hatched from the egg.

Shortly before returning to its home stream, the adult salmon is one of the prize commercial fish of the world. The value of each season's catch is measured in millions of dollars to Canada and to the United States. The salt-water fishing grounds being about equally divided by the international boundary, any thought of improving the tributary spawning situation naturally suggests a cooperative project. The corrective measures now completed and under way are accordingly administered by the International Pacific Salmon Fisheries Commission, as created by treaty.

The chief spawning ground for the sockeye is in Canada, in the wilds of the Fraser River drainage area above Hell's Gate Canyon. If this canyon were made impassable for one complete life cycle, the races of sockeye salmon spawning above the canyon would become extinct. In fact a major catastrophe did develop in 1911 and continued until 1914, involving the dominant run of salmon of the entire upper river. This run, alone worth at least 20 million dollars every four years, was all but annihilated by natural and artificial barriers in conjunction with unfavorable river stages during the migrating season.

Hell's Gate is a box canyon approximately 120 ft wide, through which must flow the drainage from 90,000 sq miles of mountainous terrain. Through it must pass a flow comparable to that of the Columbia River at Grand Coulee. The Hell's Gate restriction results in a normal rise of 70 or more ft from low water in March to high in May or June.

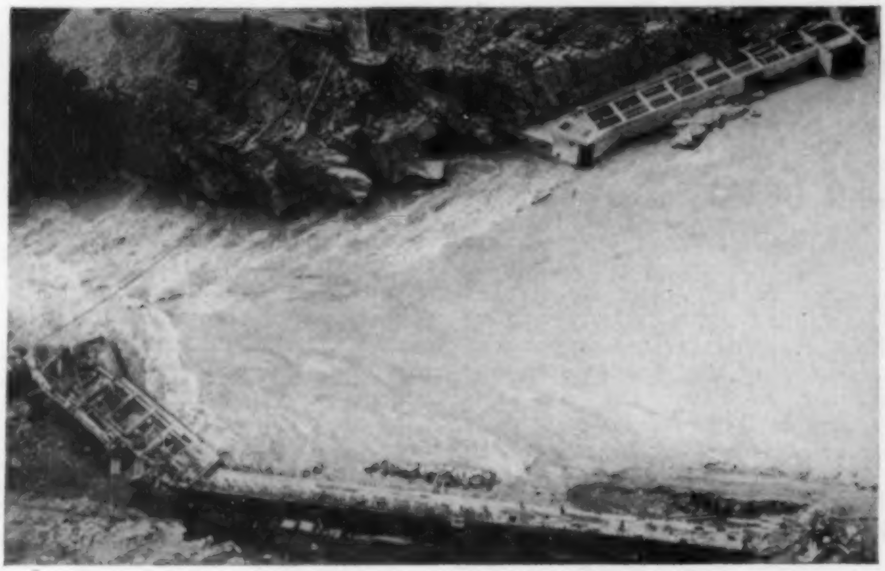
A carefully planned biological investigation, covering a period of several consecutive years, revealed a remarkable correlation between river stages and the number of fish reaching the spawning ground. Some stages offered practically a complete blockade. For example, it was found by an elaborate system of tagging that throughout one 15-ft range of water levels substantially no fish could pass. During the most important season of migration, in the months of August and September, the river had often remained within this blocked stage for many days in succession; and vast numbers of salmon could be seen vainly wearing out their lives or resting in the back eddies below the rapids. In 1941, it is estimated that 65% of the run was destroyed before reaching the spawning grounds.

Numerous other rapids are known to exist along the course of the river, but the statistical study made by the biological department of the Commission marked Hell's Gate as the chief obstruction. An analysis of old records of fish caught by commercial fishermen, in relation to the intensity of fishing, also confirmed the fact that good and bad years correlated with previous hydrometric records as reduced to water levels at Hell's Gate. With this and other unmistakable evidence, it was possible to secure for the entire river an appropriation of approximately one million dollars from each of the two governments. This immediate financial support made it possible to begin work on remedial measures without delay. The basic studies having preceded the main appropriations, the final design was promptly finished in the spring of 1944 and construction was begun as soon as the river receded for the winter season.

Two fishways, both of which are now completed, have been made effective throughout 37 ft of the river's stages. The floor level of these corrective structures lies 10 ft above the average low water, and the deck is approximately 50 ft above this low river stage. Since the salmon had shown less difficulty in passing the natural barrier during stages either above or below these levels, simple auxiliary passages may be constructed later.

The various field data were incorporated into a 1:50 natural scale model at the hydraulics laboratory of the University of Washington in Seattle, where extensive studies were

Hell's Gate Canyon on the Frazer River in British Columbia



Fishways at Half Flood Stage

made by engineers appointed by the Commission. It was from these studies that the new type of fishway was developed.

It had been obvious from the first that a conventional type of fish ladder with weirs or small orifices at fixed levels was impractical at this location, largely because of the wide and rapid changes in river stages, but also because these sockeye salmon do not choose to jump over obstacles if they can nose around them. They do not of their own choice swim either on the surface or at great depth.

The topography of the canyon being quite sheer for several miles above and below the major restriction at Hell's Gate, the slope of the gradient within the restriction is not greatly affected by the stage of the river. The water at all stages flows at a high velocity, exceeding 25 ft per sec, the gradient dropping approximately 8 ft in this immediate vicinity. But since this concentrated fall remains reasonably constant throughout the range of river stages in which the fish are blocked, the feasibility of some type of continuous orifice was naturally indicated.

It was of vital importance that frequent adjustment of gates be avoided. First, the site is somewhat isolated from the labor market and the river may rise or fall several feet in one night. Second, the fishway is deeply submerged each year by the huge river, which during the flood season rises to a height of 10 to 30 ft above the top of the structure, thus rendering a superstructure for operating machinery next to impossible.

A vertical-baffle type of fishway was accordingly developed. Openings 2 ft wide are left each side of each baffle. These openings extend uninterruptedly from the bottom to the top of the 40-ft height, affording the same horizontal pattern of flow at all river stages. (See Fig. 1.) Velocities through the openings are not influenced by the height of the river, and at any one stage are substantially

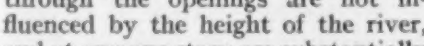


Fig. 1. Baffles in Fishway Reduce Velocity of Stream

the same from the surface to the bottom of the fishway. The salmon accordingly swim at their chosen depth without meeting any obstruction.

Migration of fish through the fishway is not spectacular. The salmon do not jump or rise to the surface. This, together with the fact that the Fraser River water is normally turbid, prevents the observer from seeing more than an occasional fish.

The main fishways are 20 ft wide by 40 ft deep, with baffle walls placed every 18 ft. The maximum differential of water surface between adjacent pools is approximately one foot, a figure no smaller than found in older designs of successful fish ladders. This limits the velocity through the various openings to 8 ft per sec, a speed easily overcome intermittently by these active salmon.

Several types of vertical baffle were investigated at the laboratory, the simplest being plain ones considerably narrower than the body of the fishway, staggered alternately from side to side in a conventional manner. This circuitous passage is not particularly inviting to the fish since it blocks the easy passage along a single wall. It also greatly increases the length of travel. A modification of this baffle, however, is attractive. If the vertical baffles are placed alternately, first near one wall and then near the other, a reasonable passage can be secured on both sides of every baffle. Both walls then become unobstructed and the passage distance much reduced. This is the arrangement adopted for the 300 ft of 12-ft upstream extension of the left-bank structure and the proposed high-level auxiliary fishway on the right bank, where the surface differential is less than 6 in.

These alternating baffles were not selected for the main 20-ft section because the velocity through the narrower of the two slits would have been 12 ft per sec. It was considered unwise to invite passage along a wall where periodically the fish would encounter such a hindrance; for it must be remembered that although some of these salmon may travel 1,000 miles after leaving salt water, they accept no food after entering the fresh water at the mouth of the river.

Although the main baffles for the 20-ft fishways at Hell's Gate are symmetrically placed on the center line of the fishway, with equal openings on each side as previously shown, narrow pilasters project from each wall to direct the streams away from the wall and toward the center of the next baffle. This system affords several advantages. The fish can follow parallel to either wall and yet escape the high velocities for a large part of their travel. The main currents have their velocities killed in the stationary water immediately above the baffle, so afford little velocity-head to influence subsequent velocities. The re-formed velocities from the turbulent region are directed perpendicularly against the main side walls, thus providing a definite neutral area in the direct path of the migrating salmon.

In order to place this neutral area in a favorable position for the fish to recover and subsequently to regain his lost momentum, and at the same time to increase the effectiveness of the baffle as such, a channel-shaped vertical baffle was developed having 4-ft concrete flanges directed upstream. This shape has the additional advan-

tage of contributing to the structural strength found necessary to overcome the emergency hydrostatic loads.

A centrally located flood-gate is provided for the lower third of each baffle, but these gates are not for the purpose of providing daily adjustment. In fact, when once set with the opening at an optimum, they may remain more or less permanently in that position. They have been kept closed while the fishways have been in operation.

Location and design of the fish entrance were given major attention. Salmon should not be required to search for some obscure opening, nor should they be expected to enter at those points below the obstruction where previously they had congregated. If a fishway is working properly there is no congestion of salmon in these back eddies. The entrance is accordingly located as near as possible to the natural current and made to furnish passable velocities in the very margin of the impassable stream (Fig. 2). The salmon in avoiding the high velocities are guided to the entrance without loss of time or energy. This separation of low and high velocities is accomplished by a training wall formed by extending the outer wall of the fishway downstream 5 ft below the fish entrance. The trailing edge of this wall is directed slightly into the main current and is tapered sharply at its downstream end.

Velocities issuing from the fish entrance will later be brought under control by a sliding leaf gate operated from the deck above by means of a special worm-gear acting through a spur-gear segment. The operating gear is below the steel grating which forms the deck. Portable hand-wheels are included, and a means of attaching portable motors if desired.

These fishways were conceived on the principle of permitting the salmon to proceed in the natural channel as far upstream as possible before encountering artificial structures. Some minor improvement of the bank was accordingly found advantageous along the river margin immediately below each fishway. On the left bank the main nose of rock was cut back 15 to 20 ft, thus enlarging and improving the waiting pool adjacent to the entrance. On the right bank this same procedure was followed and, as an additional improvement, a tunnel approximately 100 ft in length was driven behind the jagged cliff against which strong natural currents impinge. It is not the strength of the current, however, that presents the main obstacle for the salmon along this cliff. It is the extreme tur-

Construction Camp Above Fishway Entrance to Tunnel at Left

bulence and upwelling that keeps the fish continuously out of control.

The tunnel has a minimum section of 12 ft in width by 40 ft in height. It accommodates the fish at all stages of the river that are served by the fishway itself. Using a tunnel instead of a formal fishway in this location is possible because of the flat gradient. No baffles are necessary. In fact, negative velocities are barely averted at some stages.

The necessity for leaving the project unhampered by experimentation directed the policy of the Commission toward keeping the lower river bed in its original condition both during and after the construction of the major fishways. Some of the features that might be slightly hampered by this policy can be cautiously eliminated after the major elements are complete. An example is the wave action or surge that tends to disturb the surface of the waiting pool at the fish entrance. This speculatory defect seems more apparent to the human observer than to the salmon, judging by the manner in which the fish ignore it.

If the original conditions of flow are to be maintained at both lower and

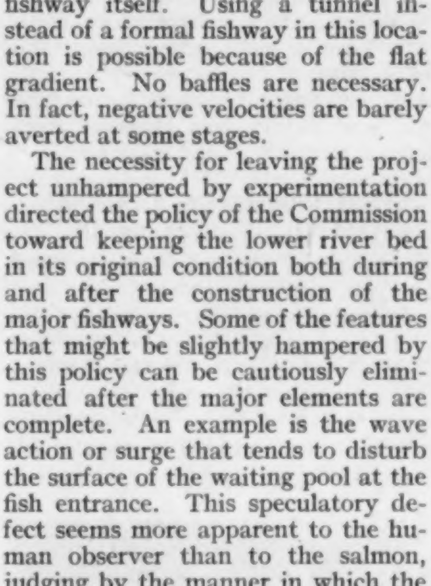


Fig. 2. Training Walls at Entrance to Fishway

higher stages, the sloping entrance wall shown in the photograph is a necessary feature. A vertical wall, to be correct for the higher stages, would change the marginal condition at the lower stages to such an extent as to modify those river currents that were already satisfactory. On the other hand, if the conditions of the lower stages were preserved and the wall made vertical, an appreciable increase in drop would result at the higher stages. Neither of these modifications of the natural features were considered judicious, so the wall was given an upstream batter of 1 horizontal to 2 vertical. This preserves the natural gradient at all stages.

The partially completed structures were immediately submerged by the rising water in the spring of 1945, and disappeared from view for a number of weeks, emerging late in June. By the end of July the peak of the Stuart Lake run of salmon had passed, despite the fact that fewer than half of the temporary stop-logs had been removed. The biological report shows that these fish arrived at the spawning grounds, some 600 miles to the north, without delay and in fine physical condition. The Chilko Lake run of approximately 200,000 fish followed in August. This latter run passed through Hell's Gate during the river stage at which the salmon had previously been completely blocked. There was none of the old-time congestion of salmon in the river, either at Hell's Gate itself or in the back eddies below. Vertical baffles are proved to be effective.

As this paper goes to press the fishways are in the midst of their second operating season. The spring flood kept them submerged until early in July with a maximum depth of 23 ft over the top of the structures.

Use of Native Materials Features Construction of Puerto Rico Water System

By Ernest W. Whitlock, M. ASCE

Partner, Malcolm Pirnie Engineers, New York, N.Y.

Two dams, nearly fourteen miles of reinforced concrete pipe, a distribution reservoir and other facilities were constructed largely from Puerto Rican materials to augment the San Juan water supply system. War's pressure on time for construction necessitated numerous expedients, one of them being the use of aerial survey maps to locate reservoirs and pipe lines in the nearly inaccessible terrain. So that local contractors could complete the work, the project was divided into many small contracts. Total cost was about five million dollars.

To augment the inadequate water supply system of San Juan, capital city of Puerto Rico, during war years, extensive new facilities were constructed. Unusual conditions dictated the greatest possible use of materials, equipment, and labor from Puerto Rican sources. Fortunately, cement manufactured in Puerto Rico, local sand, crushed stone for concrete, and an adequate supply of labor were available. The work was divided into a number of contracts so that it could be handled by local contractors. The District Engineer of the San Juan District, U.S. Engineer Department, acted as contracting officer for the Federal Works Agency during most of the construction period.

Because of Army and Navy operations in the area, the city was faced with a demand of 26 mgd in dry weather and an available supply of but 16 mgd. The new facilities were therefore expedited to make up the difference. The facilities approved by the FWA and the War Production Board to meet the requirements included the following, shown in Fig. 1:

1. A ten-million-gallon distribution reservoir.
2. A new 42-in. main (Line A) with 36-in. branches.
3. A storage reservoir formed by the new concrete gravity-type Cidra Dam.
4. New intake facilities at the existing Aguas Buenas Diversion Dam.
5. Line B, a 36-in. line about $7^1/_2$ miles long.
6. A storage reservoir formed by the new Rio Piedras Dam, of compacted earth.

DISTRIBUTION RESERVOIR COVERED

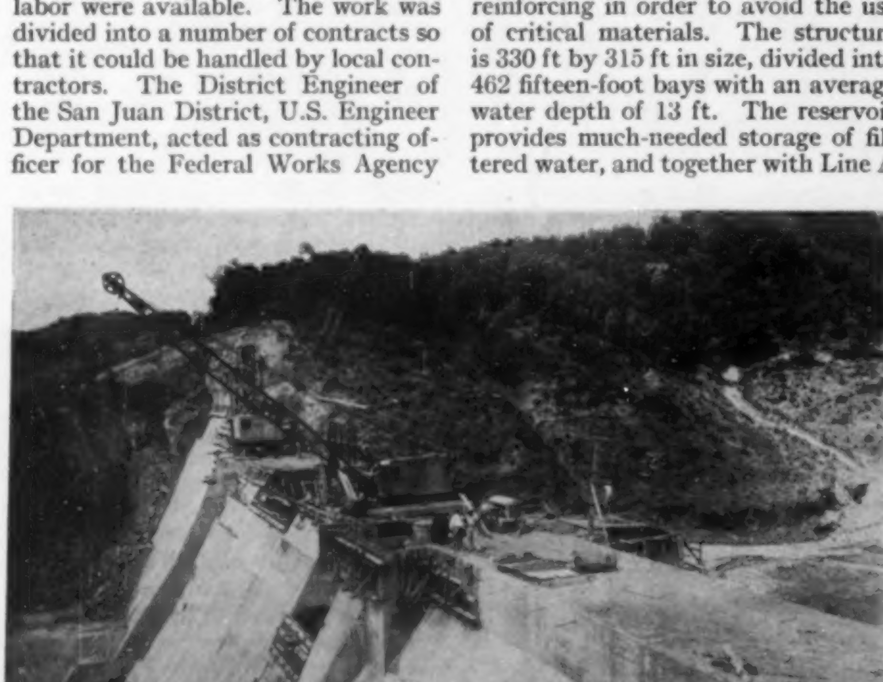
The distribution reservoir was designed as a groined-arch, covered concrete structure without any steel reinforcing in order to avoid the use of critical materials. The structure is 330 ft by 315 ft in size, divided into 462 fifteen-foot bays with an average water depth of 13 ft. The reservoir provides much-needed storage of filtered water, and together with Line A permits maximum hourly consumption at a 40-mgd rate as compared to the 20-mgd rate which is the capacity of the existing 30-in. main from Guaynabo filter plant operating alone.

Reinforced Concrete Pipe Was Placed by the Backhoes That Prepared the Trenches

Approximately 70,000 ft of pipe, 36 in. and 42 in. in diameter, designed for heads of from 100 to 450 ft, was required for Line A and Line B. The use of prestressed, reinforced steel-cylinder concrete pipe permitted maximum utilization of local labor and materials and minimum use of steel reinforcing and shipping space.

The Lock Joint Pipe Company of Puerto Rico was awarded the contract for the manufacture of the pipe. A new plant was built by the company at Hato Rey near its existing sewer-pipe plant. A few key men, experienced in the manufacture of this type of pipe, were sent to Puerto Rico to establish and supervise operation of the plant, and in a remarkably short time an efficient operating crew of local mechanics and laborers were trained to carry out the operations of welding and testing the cylinders and applying the interior concrete lining, reinforcing steel, and exterior coating.

The pipe consists of a continuous arc-welded steel cylinder with steel joint rings welded to its ends, lined



Construction of Cidra Dam Provided a Regulated Yield of 24 Mgd

with centrifugally placed concrete, then wrapped with high-tensile-strength reinforcing wire under tension, and coated with cement mortar.

The section of Line A in and near Caño de Martin Peña crosses a tidal inlet from San Juan Bay about 400 ft wide, with a low marshy area on each side. For the crossing special subaqueous pipe was used, with 6-in. walls of sufficient weight to sink when filled with air, and with bolts and lugs at the joints to draw them together. The water averaged about 10 ft in depth, and there was from 3 to 5 ft of muck on the bottom, overlying stiff clay. The pipe was installed on crushed-stone ballast leveled to grade in a trench excavated into the clay. The subcontractor who installed the subaqueous pipe employed a novel and effective method for the work. The trench for the crossing was excavated by means of floating equipment, and a pile-bent trestle was constructed on line.

ASSEMBLED UNDER WATER

The pipe was assembled just under water and supported by U-bolts hung from the bents. A steel cable inside the pipe was attached to caps on both ends and brought under tension to assure that there would be no undue stress on the jointing lugs during the lowering process.

A sheave was mounted on the trestle above each length of pipe and a steel cable, attached to a sling on the pipe, was carried up and over each sheave. These, in turn, were clamped to a main cable which ran the length of the trestle. The clamps were adjusted to give equal tension on all lowering lines, and the pipe was dewatered to reduce its weight and test it for leaks.

The next step was the removal of the U-bolt hangers, after which the pipe was lowered gradually by slacking off on the main cable.

EIGHT TUNNELS ON LINE B

Storage provided by the new dam at Cidra increased the dependable dry-weather yield at the Aguas Buenas intake from 5 to 24 mgd, and Line B was constructed to deliver this flow by gravity to the filter plant. This line is composed of diversion and intake works at the Aguas Buenas Dam, eight tunnels through steep, high ridges, and approximately 30,000 ft of 36-in. pipe line.

A low concrete diversion dam was constructed across the Bayamon River above its entrance into the existing small, silt-filled reservoir. An intake structure and a 42-in. cast-in-place conduit, 2,500 ft long, were built on the bank of the river to lead the diverted water past the reservoir and directly into a new intake shaft near the dam. This will allow service to be maintained to the Guaynabo Filters while the reservoir is being cleaned or blown down to remove silt deposits during and after floods to keep it clean.

The intake shaft and baf e wall between it and the reservoir are so constructed that selection of the best available water can be made during high flows. Special provisions were made in these structures, as well as in the diversion works, to insure their stability and proper functioning when subjected to the heavy debris-laden flows resulting from torrential rains during the hurricane season.

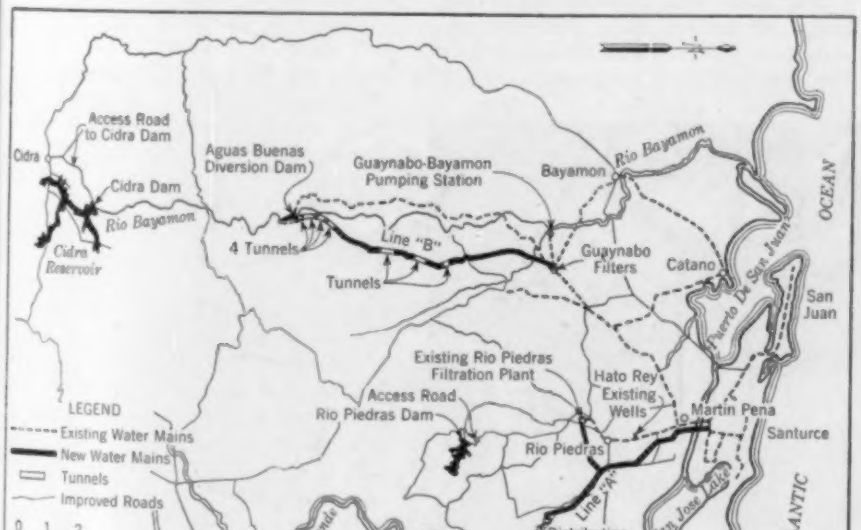
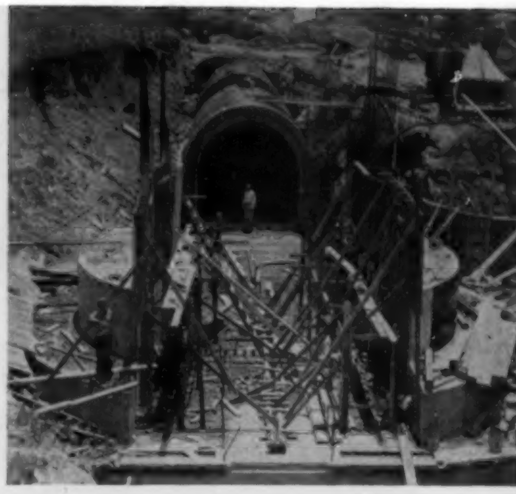


FIG. 1. EXTENSIVE FACILITIES CONSTRUCTED TO AUGMENT WATER SUPPLY AT SAN JUAN, PUERTO RICO



CONCRETE FOR STRUCTURES UTILIZED PUERTO RICAN CEMENT AND AGGREGATE AND WAS MIXED ON THE SITE

The terrain traversed by Line B is very rough, which made surveys difficult and required special skill in pipe handling and laying. Advance U.S. Geological Survey maps based on aerial surveys were used to determine the best route for the line.

With the general alinement known, all local location and alinement were determined in the field, and the line was staked and surveyed as determined by on-the-spot reconnaissance. The more usual method of making surveys, plotting, office location, and staking of the final location in the field, if used on the terrain traversed, would have introduced many inaccuracies and required much more time than was available.

SPECIAL TRUCKS DELIVER PIPE

Delivery of pipe was made by 10 wheel-drive trucks traveling on bulldozed access roads, and by a specially built tractor-drawn wagon, which consisted of a steel frame and derrick mounted on two carryall wheels. Industrial track and small cars were used to handle pipe and materials on some of the steeper hills, and when rains turned the access roads into mud, pack horses and manpower were called on to carry fuel, cement, and supplies to the pipe-laying crews. All except two sections of the pipe line, which were on very steep hills, were laid by backhoes, which also excavated the trench. These machines, anchored to winch tractors and deadmen, excavated trench and laid pipe on hills with grades up to 50%.

A control chamber was built at the lower end of the line to regulate flows and to provide flushing outlets which can be opened to develop high velocities in the pipe and thus remove silt which will accumulate as deposited from the highly turbid waters carried. Tunnel elevations were established so that they step downward from Aguas Buenas to the filter plant to keep them just below

ROUGH TERRAIN MADE FOR "TOUGH GOING"

the hydraulic grade lines for gravity flow to the Guaynabo Filter Plant or to the Guaynabo control-chamber flushing outlets.

Ground water was encountered in the tunnels at numerous locations, and when first tapped some veins gave a flow of up to an estimated 200 gpm. This decreased to a relatively small seepage in a matter of days. No attempt was made to make the tunnels watertight in themselves. This would have required practically continuous concrete lining and a very large amount of grouting. From all appearances it was questionable whether complete sealing of the tunnels would represent a saving in water carried or a loss of possible additional water from seepage. Concrete lining was placed in sections of the tunnels only to insure their stability and not to make them watertight.

CIDRA STORAGE RESERVOIR

Cidra Reservoir has a storage capacity of 5,350 acre-ft of water at its flow line and a water surface area of 235 acres. It is estimated that the storage provided will increase the yield of the stream to 24 mgd in a 95% dry year.

The dam is a gravity-type concrete structure with an overflow section designed to discharge at least 24,000 cu ft per sec, equivalent to 3,000 cu per ft per sec per sq mile, a high figure as compared with requirements in most parts of the United States. The dam is 550 ft long, including overflow and non-overflow gravity sections and concrete cutoff walls 10 ft thick, which were carried into the hillsides at each end. The spillway section is about 100 ft high in the center. This section of the dam is 132 ft long and a stilling pool is excavated at its toe to dissipate the energy of flood flows.

Outlet works were incorporated into the non-overflow section on the south side, consisting of a wet well upstream and a control chamber downstream. Upper and lower inlets are provided to draw water from the reservoir into the wet well. The main inlet is located at stream-bed level, and its use will prevent concentrations of unsatisfactory water at the bottom. It is protected by a concrete chamber with slotted sections and consists of a 42-in. reinforced concrete pipe extending to the wet well, with flow controlled by a 42-in. sluice gate in the wall of the wet well. A 42-in. outlet, controlled by a sluice gate, extends through the dam, to permit flushing out the bottom waters of the reservoir at times of heavy flood flow.

The wet well is connected to a concrete riser in the dry well through a pipe containing a venturi meter for measuring the discharge. Gated outlets at three levels are provided from the riser to the downstream face of the dam. These are designed to provide regulation of the flow from the reservoir when it is at different levels, with a minimum of throttling and wearing of valves.

The dam was constructed in sections 10 meters long between construction joints. The foundations of the four spillway sections were carried down about 20 ft below stream level into the andesitic rock. This rock was highly fractured in an irregular manner but the seams were very fine and relatively impervious, as indicated by the small amount of water entering the excavations for the foundations. The two non-overflow sections on each side of the spillway were carried into hard andesite but the remaining sections were founded on materials of gradually decreasing hardness as the foundation level rose and the resulting loads decreased. The cutoff walls were poured in a trench cut through firm red clay to the upper part of the soft or decomposed rock locally termed

ROOF OF DISTRIBUTION RESERVOIR WAS SUPPORTED ON GROINED ARCHES

"tosca." Compacted earth fill with riprap protection was placed on the upstream face of the abutments, and stone fill was placed against the downstream face.

GROUTING THE DAM FOUNDATIONS

The upstream third of the dam foundations was grouted to a depth of 30 ft in three stages. The first stage consisted of grouting holes 6 ft deep and about 6 ft apart at pressures of 25 lb per sq in.; the second stage, of grouting holes 18 ft deep about 10 ft apart at pressures of 50 lb per sq in.; and the third stage, of grouting holes 30 ft deep and about 10 ft apart at pressures of 100 lb per sq in.

Concrete for the dam had an average slump of $1^1/_2$ in., a 28-day compression strength of 4,000 lb per sq in., and contained 1.2 bbl per cu yd of medium heat-of-hydration cement. All concrete placed was vibrated with electrically driven internal vibrators. Concrete pours were limited to a height of 5 ft, and intervals of 4 days were required between horizontal pours and of 6 days between vertical pours.

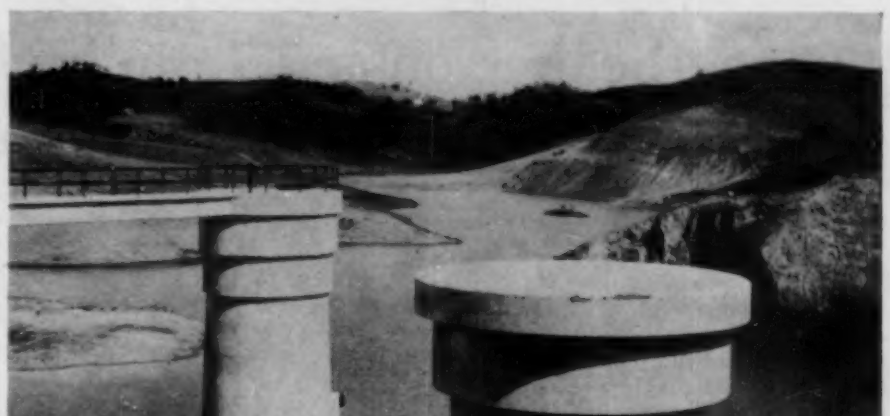
The Rio Piedras storage reservoir has a storage capacity of 1,130 acre-

SPECIALLY BUILT WAGON TRANSPORTED SECTIONS OF PIPE

ft, a drainage area of 1.1 sq miles, and runoff sufficient to more than fill it each year. By supplying deficiencies in the flow of the main stream it will increase the yield at the existing Rio Piedras filter plant from less than 2 mgd to 6 mgd, which is the capacity of the plant.

The dam is located on a hard-rock natural control in a narrow part of the stream valley. It is of compacted earth construction built to a maximum height of 75 ft above the foundation grade. The center third of the dam is of selected clay and tosca, forming an impervious core; harder tosca forms the outer portions to provide drainage and stability. A rock-fill toe permits downstream drainage of the embankment through a filter consisting of five layers of graded sand and crushed stone. A rock fill also is provided at the bottom of the upstream face of the dam to permit drainage from the embankment during rapid drawdown of the water level.

The dam is approximately 950 ft long, has a top width of 25 ft, and a slope of 1 vertical on 3 horizontal. The upstream face is protected by an 18-in. thickness of hand-placed riprap laid on 6 in. of crushed stone and 4 in. of sand. Topsoil and grassing are provided on the downstream face to prevent erosion.



ROLLING HILLS AT RIO PIEDRAS DAM
Intake Towers and Morning-Glory Spillway in Foreground

SPILLWAY AND DISCHARGE CONDUIT

The spillway is of the morning-glory type, with a diameter of 42 ft at the crest, and is designed to discharge 6,000 ft per sec. It discharges into a 13-ft horseshoe-shaped reinforced concrete conduit constructed on a solid rock foundation through the dam. This conduit also was designed to take care of stream flow during construction. Discharge facilities consist of three inlets at different levels leading into a circular control tower at the upstream toe of the dam adjacent to the spillway discharge conduit, into which flows through the control tower also are discharged. Measurement of flows by orifice meters is provided for in the design, and there is a double-gated outlet for flushing out the bottom waters during and after heavy runoff into the reservoir.

Foundations for the concrete spillway, intake tower, and discharge conduit were excavated into hard rock. Topsoil and other undesirable materials were stripped from the abutment to form the foundation of the earth embankment. The rock underlying the dam was found to be relatively tight, but more porous material was encountered above the rock. This was grouted for the full length of the dam to form a tight cut-off curtain parallel to the axis. Various methods of drilling and grouting were used. In general, the material was grouted in three stages, low pressures being used for the top grouting and higher pressures for the bottom grouting which extended into hard rock.

PLANT FOR MANUFACTURE OF CONCRETE PIPE WAS ESTABLISHED AT HATO REY

GENERAL DATA ON THE PROJECT

The total cost of the work, including engineering and supervision, was approximately $5,100,000. Construction on the project was begun late in 1943 and entirely completed early in 1946. However, various elements of the project were put into operation as they were completed, in 1944 and 1945.

The original studies and report on the project were made by Malcolm Pirnie, Past-President ASCE, consulting engineer to the Capital of Puerto Rico. Later he was retained by the Federal Works Agency to prepare plans, specifications, and record drawings and to provide general supervision service and advice to Ricardo Skerrett, Territorial Representative of the Federal Works Agency.

In Puerto Rico the consulting engineer's organization on the work included Rafael A. Gonzalez, M. ASCE, Executive Engineer; Alfred W. Sawyer, Assoc. M. ASCE, resident engineer on the distribution reservoir, pipe lines, and tunnels; Carl A. Arenander, Assoc. M. ASCE, resident engineer on the two reservoir projects; and Albert L. Blackwell, office engineer. Mr. Pirnie and the writer directed the work of the consulting engineer's organization and kept in close contact with it by frequent trips to Puerto Rico.

The U.S. Engineer Department was represented by Col. W. J. Truss, Col. Aubrey H. Bond, and Lt. Col. Loren W. Olmstead as Contracting Officer at various periods during the progress of the work; and Maj. Joseph A. Novaro, Assoc. M. ASCE, was project engineer during the full period of construction.

Large-Scale Construction Techniques Called for by Housing Program

By Wilson W. Wyatt

National Housing Expediter; Administrator, National Housing Agency, Washington, D.C.

NEW fields of activity for civil engineers are being opened up by the critical housing shortage confronting us today. The building of homes has become a challenge to many who were principally engaged in commercial and industrial building in the past.

The challenge arises first of all from a realization of the serious housing dilemma in which we find ourselves. Over a million American families are living doubled up with other families. Over two million newly married veterans are vainly pounding the pavements in search of housing accommodations, and additional thousands of non-veterans are getting married each month and joining the futile hunt.

To meet the crisis, the Veterans Emergency Housing Program has set a bold target of 2,700,000 homes and apartments to be started for veterans by the end of 1947. This calls for the greatest house-building effort in the history of the nation. It means building 1,200,000 units in 1946 and 1,500,000 in 1947 as compared to the biggest building year in our history—937,000 units in 1925—but this time starting with an industry badly disrupted by war. It means exceeding the 1945 home-building efforts in dollar volume by 350% in 1946 and again exceeding that by 70% in 1947.

If we are to meet these goals we must undertake the mass building of homes for the first time in history—a job of a magnitude requiring not only the accelerated efforts of the home-building industry but the ingenuity and resourcefulness of many professional people such as our construction and civil engineers, who ordinarily are not concerned with the building of homes.

MATERIALS DIVERTED TO HOUSING

By Government order we have postponed certain large-scale private and federal building projects and non-essential construction activities so that critically short materials will be diverted to the residential building job. This curtailment of large-scale building has directly affected the principal occupation of many civil and construction engineers and has caused them to turn their attention to home building. To meet our goals we must take advantage of their know-how in applying large-scale construction techniques to the job of building houses.

To build communities of small houses in volume or to construct huge quantities of apartment houses, we need the overall capabilities of the large constructor, his skill in handling equipment and organizing construction activities economically. A construction engineer told me recently of a method he has devised on a dam-construction project which saved a pound of cement on every barrel used. This new technique saved the builder \$50,000. Similar money-saving techniques could conceivably be applied in residential construction as well.

OPPORTUNITY FOR MASS PRODUCTION

Of particular interest to the large constructor are developments in the building of houses of concrete—a material with which he is very well acquainted. There is much promise here for mass production. Materials needed in such construction are ample in supply and relatively low in cost. Further, large equipment made idle by the curtailment of deferrable building can be turned to the house-building field. Already we have examples of the use of heavy equipment in home building. One large constructor plans to use 47 cranes in building 90 concrete homes a day.

The civil engineer is necessary to the home-building program in other ways: in laying out and preparing sites for new building; in grading; in constructing roads and sidewalks; in installing electric, gas, water, and telephone utilities; and in proper planning of storm and sanitary sewers. Civil engineers are serving on local committees dealing with modernization of local building codes and zoning ordinances and other problems directly related to the housing program. They are also serving as consultants to local planning and housing authorities. But above all they are needed in the building of homes on a mass scale. The success of the emergency program hinges on the mass building of houses because by building them on a large scale we will get them faster and less expensively than by resorting to traditional methods.

Recognizing the need for the technical knowledge and experience of civil engineers, the National Housing Agency has brought many of them into the administrative and technical end of the Veterans Emergency Housing Program. There are 22 civil engineers on the National Housing Agency staff in Washington and another 23 in NHA field offices.

CONSTRUCTION BRANCH ESTABLISHED

We have established a Construction Branch to encourage the interest of large-scale building organizations and to stimulate the use of new designs, materials, and methods of construction. Its staff is available for consultation to provide information services to builders and engineers and to encourage the interchange of ideas on construction practices and new and better uses of materials.

Our Technical Branch is concerned with modern materials, with new and improved techniques of distribution and assembly, and with determining the eligibility of new materials and processes for financial assistance from the National Housing Agency.

There is a definite place for the civil engineer in the large-scale building of houses. There is a place for him in related industries producing building materials and construction equipment. There is a place for him in the development of supporting services that precede the building of houses. There is a continuing need for him in the building of essential structures not curtailed under the Veterans Emergency Housing Program.

As more and more houses go up, as more and more roofs go over the heads of our veterans, there will be increasing need for community facilities to go along with the new developments. As the emergency housing goal is reached, many important engineering and construction projects will be resumed. This will give engineers a chance to return to their former occupations or to remain in the house-building field, which will have continuing needs for many years to come.

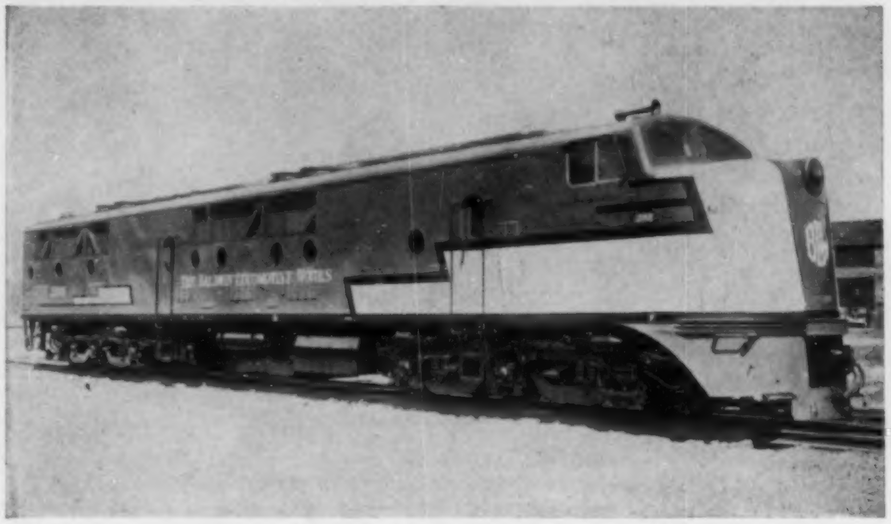
Railroads' Motive Power Costs Analyzed

Comparison Shows Advantages of Diesel Over Steam Power

By A. H. Candee

Transportation Engineer, Westinghouse Electric Corporation, East Pittsburgh, Pa.

ECONOMY resulting from the use of diesel-powered locomotives is due in large part to certain characteristics which permit operation over long periods with a minimum of time out for maintenance. It is recognized that cost figures vary somewhat with various lines, yet Mr. Candee concludes that for both switching and road service the diesels save money. He presented this paper before the Cleveland Section of ASCE.



Diesel Road Locomotive with Two 1,000-Hp Engines

Table I. Cost Comparison of Steam and Diesel Switching Locomotives, in Dollars per Hour

Items	Present Steam	Six 1,000-Hp Diesels	Three 1,500-Hp Diesels
Crew wages, assigned time	$5.5090	$5.3772	$5.3772
Crew wages, overtime	8.0658	8.0658	8.0658
Fuel	1.8750	0.4500	0.6000
Water	0.C786	......	......
Lubricants	0.0339	0.0450	0.0600
Other supplies	0.0447	0.0223	0.0223
Enginehouse expense	0.9300	0.4500	0.4500
Repairs	1.3350	0.4500	0.6000
Total per assigned hour	$9.8062	$6.7945	$7.1095
Total per overtime hour	12.3630	9.4831	9.7981
Assigned hours per year	57,000	31,665	19,985
Overtime hours per year	1,500	790	500
Total hours	58,500	32,455	20,485
Annual cost	$577,498	$222,640	$146,982
Total annual operating expense	$577,498	$369,622	
Depreciation charges	26 280	42,800	
Total annual expense	$603,778	$412,422	
Savings by diesels:			
Total annual			$191,356
Relation to net investment			22.1%

NEARLY 40% of the operating expense of a railroad is affected by the characteristics of the motive power used. Consequently, types and costs of motive power are carefully scrutinized by all railroad executives. It is on this basis of comparative costs and performance that the historical supremacy of the steam locomotive is being challenged by a relative newcomer in the field, the diesel-powered locomotive. Railroad accounting classifies the expenses that may be directly charged against locomotive operation, of which eight important cost items must be considered. These are crew wages, fuel, water, lubricants, other supplies, enginehouse expense, repairs, and depreciation. Of these, the differences between steam and diesel locomotive costs for wages, water, and "other supplies" are of relatively little importance.

Diesel economies stem from the savings in fuel, enginehouse expense, and repair costs. Balanced against these savings is the depreciation charge, which is an annual one based on purchase price and presumably sets up a fund for replacement by the end of the useful life of the locomotive. Since a diesel normally costs more than a corresponding steam locomotive, its annual mileage must be sufficiently high so that the savings per mile multiplied by the annual mileage will more than overbalance the higher depreciation charge.

OIL-COAL COSTS COMPARED

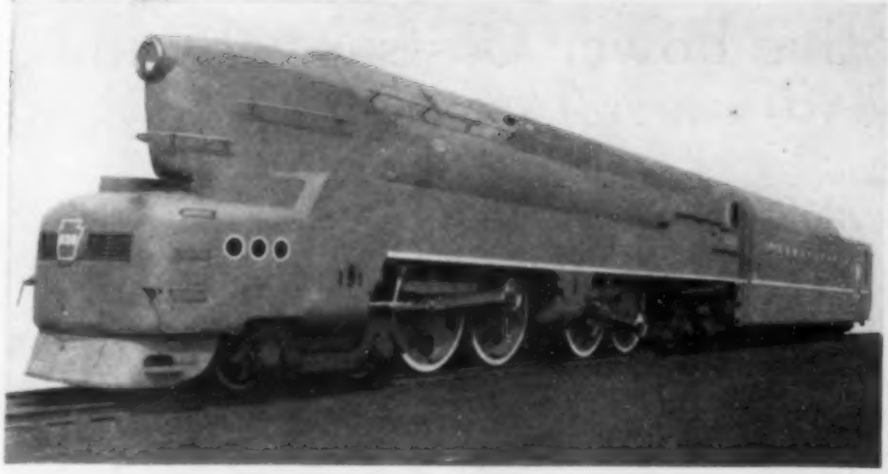
As may be expected, steam and diesel fuel expenses vary widely in different parts of the country. A typical fuel comparison, based on the experience of one large railroad using diesels in all types of service, shows that the work done by a ton of coal burned in a steam locomotive can be duplicated by the fuel burned in a diesel in the ratios of 15 gal to a ton in switching service, 35 gal to a ton in freight service, and 38 gal to a ton when hauling passenger trains. In order to evaluate the unit fuel costs for equal cost per mile, a table has been prepared which recognizes the higher costs of lubricants for diesel locomotives:

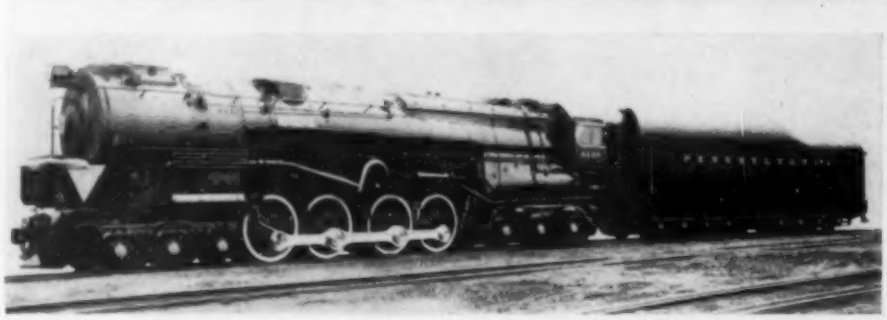
With a Diesel Fuel Cost per Gal of	Steam Locomotive Fuel Cost is Higher if the per Ton Cost of Coal Is More Than		
	Switching	Freight	Passenger
$0.05	$0.80	$1.87	$2.02
0.07	1.13	2.63	2.83
0.09	1.45	3.38	3.67

Steam-locomotive coal is generally much higher than the figures shown, so that fuel costs are in favor of the diesel, even if its fuel price were eventually to reach the $0.09 figure.

ENGINEERING EXPENSE DEFINED

The cost item designated as "enginehouse expense" covers routine work at a terminal to care for and to prepare a locomotive for its next run. Costs include those for wiping and cleaning, watching, cleaning fires, dumping ashes, washing boilers, removing ashes, drying sand, and mov-





TO IMPROVE OPERATING CHARACTERISTICS OF STEAM LOCOMOTIVES, FOUR-CYLINDER (ABOVE) AND TURBINE (CENTER) DESIGNS HAVE BEEN DEVELOPED TO REPLACE CONVENTIONAL TWO-CYLINDER TYPE (BELOW)

ing locomotives at the terminal. Since a diesel requires very little of these services, this item of expense is invariably much lower than for steam.

Locomotive repair expense is an exceedingly variable item. So much depends on the supervisory force, the facilities available, quality of water, and the locomotive load factor that no general comparisons between different types of motive power should be permitted. Since the repair of a steam locomotive involves periodic operations of considerable expense (such as removal of boiler tubes and flues every four years for a thorough boiler inspection), all comparisons must be made on the basis of average expense over a long term of years. It has been found, however, that diesel locomotive repair costs are considerably lower than for steam, even when the most modern type of steam locomotive is considered.

The rates of depreciation that may be charged against motive power are fixed by the Interstate Commerce Commission and vary considerably for different railroads and types of power. The general tendency is to place a higher rate on diesel power than on steam, probably on the mistaken basis that a diesel unit has a shorter life than a steam locomotive. Since a diesel is normally higher in price than the corresponding steam locomotive, this constitutes a heavy countercharge against the operating savings.

Consideration of economies cannot always be based on a unit-for-unit cost comparison, since one type or size of locomotive may be able to do more work than another. Thus, if a railroad's track structure and bridges limit steam power to a locomotive that develops a maximum of 3,000 hp, while the wheel loads and axle spacings of a diesel are such that a locomotive may be applied which can develop 5,000 hp at the rims of the drivers (corresponding to 6,000 diesel engine hp), the diesel should be able to handle the total daily tonnage with fewer trips, thereby saving crew expense. In switching work, it is often found that two diesels will do the work of three steam switchers because of improved performance.

TABLE II. COST COMPARISON OF STEAM AND DIESEL FREIGHT LOCOMOTIVES, IN DOLLARS PER MILE

Items	One 2-8-4 Steam	One 3,000-Hp Diesel
Enginemen's wages	$0.183	$0.192
Fuel	0.650	0.300
Water	0.038	...
Lubricants	0.005	0.030
Other supplies	0.010	0.005
Enginehouse expense	0.052	0.040
Repairs	0.200	0.150
Total	$1.138	$0.717
Miles per year	75,000	75,000
Annual operating cost	$85,300	$53,800
Depreciation charge	6,200	11,000
	$91,500	$64,800
Savings:		
Annual, per diesel locomotive		$26,700
Relation to increase in investment		35.6%

ACTUAL COSTS STUDIED

A typical cost comparison is shown in Table I, which is based on an actual study made on a terminal switching railroad. The steam switching power consisted of 12 locomotives which could be replaced by six 1,000-hp and three 1,500-hp diesels. This is a comparison between existing locomotives and new diesels. If it were made between new steam locomotives and new diesels, the savings would be lower, but would show a much higher percentage return on the difference in investments.

ROAD LOCOMOTIVE COMPARISON

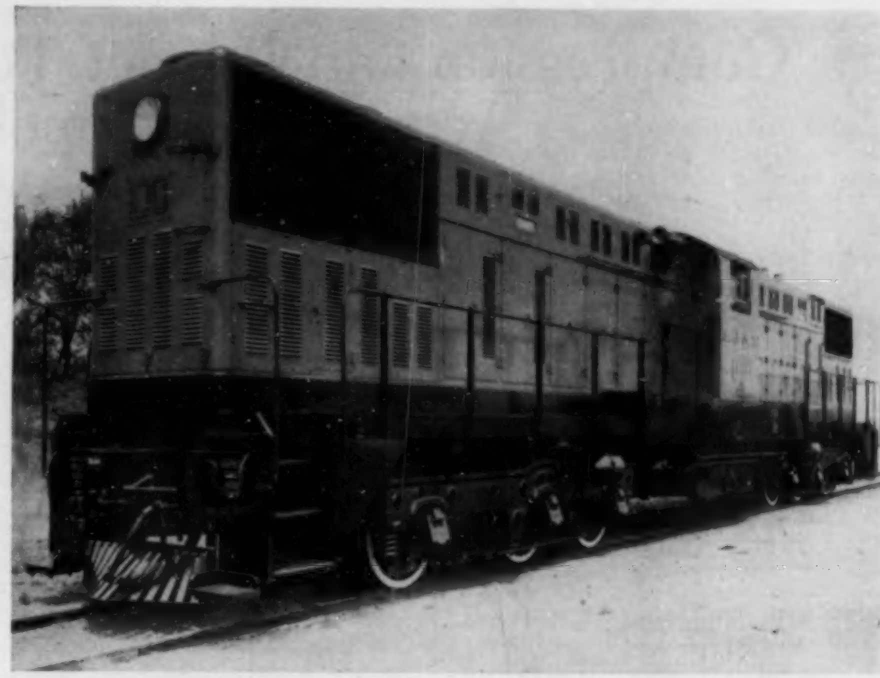
Another actual cost comparison, covering normal medium freight service (low annual mileage) is shown in Table II. Since this railroad has daily scheduled freight trains, no decrease in annual mileage can be made by the use of diesels, and consequently the comparison has been worked out for equal mileage, even though the diesel power can handle heavier tonnage than the steam locomotives. In this case, the comparison is based on the purchase of new steam locomotives or new diesel locomotives.

The diesel locomotive has fully demonstrated its operating economy over any other type except the elec-

tric locomotive. Offsetting these economies are the relatively high fixed charges both for the diesel locomotive and for electrification, so that it has normally required intensive use of such motive power to accumulate the operating savings necessary to overbalance the high fixed charges.

In switching work, diesel operating savings are normally great enough not only to justify the high fixed charges but even to warrant the scrapping of existing steam switchers and their replacement with diesels. Where new switching power is needed and the choice between steam and diesel locomotives must be made, the diesel economies generally far outweigh the small increase in price over steam for this type of power. For switching work, then, the diesel has virtually captured the field.

On the average, freight and passenger steam locomotives operate but 75 miles a day in a normal traffic year such as 1940. Since many of these make considerably more mileage than this, it is obvious that the run-of-the-mine locomotive mileage must be rather low. The three main items of expense where the diesel shows appreciable savings (fuel, repairs, and enginehouse expense) average around 40 cents per mile for the low-mileage units, so that annual savings by diesels can hardly justify the scrapping of present steam locomotives and the purchase of diesel power. It may be expected, however, that as locomotive replacements become necessary, diesels will be purchased and assigned to the higher-mileage runs, and the displaced steam locomotives set back into the lower-mileage bracket to permit retirement of obsolete locomotives generally used for those services.



A Powerful (2,000-Hp) Diesel-Electric Road-Transfer Locomotive Can Replace Four Conventional Steam Locomotives in Hauling Freight on the Chicago Outer Belt Line

Operating Advantages Shown

Designers of steam locomotives have recognized the fact that the diesel has certain inherent advantages over steam power and have taken steps to improve the latter. Thus, we have seen the development and use of 4-cylinder locomotives; the application of practical poppet valves; and the initiation of the turbine-driven locomotive. One of the factors that limit speeds of reciprocating-type steam locomotives is the impossibility of balancing side rods and connecting rods. At high speeds, the unbalanced forces wrack the locomotive and may cause severe track damage. The 4-cylinder designs reduce these unbalanced weights and forces and, in the case of the turbine locomotive, the side-rod weight can be balanced perfectly. However, the vast majority of locomotives in operation in the United States are in medium-speed service, where large locomotives, such as 4-cylinder or turbine-driven units, would be of little value.

Some of the operating differences should be explained. The wheels of a steam locomotive are normally driven directly by the cylinders through connecting rods and side rods. A diesel (except in the very small industrial sizes) employs electric motors for driving the wheels. This difference in drive results in a considerable difference in locomotive characteristics and gives the diesel some very decided advantages over steam. A few of these are listed in Table III. Many of these advantages also pertain to steam turbine locomotives.

Table III. Comparison of Steam and Diesel Operating Characteristics

Element	Reciprocating Steam	Diesel
Starting pull	25% of weight on drivers	30 to 35% of weight on drivers
Weight on drivers	Limited by weight per axle and number that can be driven by cylinders	Motors can be applied to as many axles as desired
Weight per axle	Limited by unbalanced dynamic forces	Higher weights because no unbalance
Tractive force	Fluctuates during each wheel revolution	Uniform throughout wheel revolution
Horsepower at wheels	Full power only at relatively high speed	Nearly constant through wide speed range
Maximum speed	Limited by unbalanced dynamic forces at wheels	Can be geared for any practicable speed

Progress Made in Design

The application of high-capacity diesel locomotives has been limited to some extent by the fact that diesel engines have been of relatively low capacity and it has required several of these to aggregate the required horsepower. The use of a multiplicity of engines has likewise necessitated a multiplicity of cabs for carrying these power units, resulting in excessive diesel locomotive cost. The diesel, then, has to be used intensively in order to reduce the fixed charges per mile to an acceptable figure. While this militates heavily against road diesels, the same situation obtains to some extent in switching service, even though a single engine mounted in a single cab will suffice for the service.

Progress is being made in diesel-engine design and in diesel-locomotive construction. Locomotives are now being built with single engines of 2,000 hp (former 2,000-hp locomotives had two 1,000-hp engines), and 3,000-hp cabs are being marketed (two 1,500-hp engines). The future holds promise of larger-capacity diesel engines and fewer cabs per locomotive, both of which are conducive to lower first costs and lower operating costs.

Compression and Impact Tests for Steel Acceptance Proposed

Failures Indicate Need for Higher Ductility at Low Temperatures

By D. F. Windenburg

Chief Physicist, David Taylor Model Basin, Navy Department, Washington, D.C.

Standard tests for acceptance of structural steel do not measure the compressive yield strength or the notch sensitivity of the material at low temperatures. Research at the Navy's David Taylor Model Basin has shown that an accurate measure of these mechanical properties is essential if failures are to be avoided. Thus, in a paper presented before the Structural Division of ASCE, Dr. Windenburg recommended the development of new, rapid, and automatic tests to ensure the performance of steel in economically designed structures.

During the past three or four years, disastrous failures have occurred in engineering structures which indicate the need for new consideration of the mechanical properties of structural materials. Merchant ships have broken in two, at sea or even in dock, and a gas container in Cleveland burst with considerable loss of property and life. The materials of which these structures were built all met standard specifications for elastic modulus, yield strength, ultimate strength, and elongation. The structures were similar to hundreds of others that had given years of satisfactory service and are still in operation. The loading at the time of failure was not abnormal and should have been adequately covered by the factor of safety. Yet the structures failed.

All these failures seemed to have two elements in common—they occurred at reduced temperatures, and the metal fractured without appreciable elongation. This made it appear that the materials were not ductile and that they did not meet the specifications for ductility. However, additional tensile-test coupons cut from the fractured plating, when tested according to ASTM specifications, again showed that according to these standards the material was ductile, even though it was taken from plating that had fractured in service without appreciable elongation.

The question immediately posed itself: Was this lack of ductility in a fabricated structure the result of the stress condition in the plating or was it a mechanical property of the material itself which was not reflected in the tensile-test data?

POST MORTEMS ON STRUCTURES

Extensive investigations were made of all structures that had fractured in service. Fractures apparently were initiated as cracks, which when once started were propagated so rapidly that a loud report was heard, similar to the report of a gun or the noise from a depth charge. The origin of the cracks, when traced by the herringbone pattern, was usually found in regions of high stress concentrations such as the hatch corners on merchant ships, and frequently in or near welded joints.

This indicated that the stress condition was certainly a contributing factor and pointed the finger of suspicion toward welding, since similar failures had not been experienced on older structures that had been assembled by riveting.

The onus then seemed to be on the welding or on the material or on both. It is well known that in shipbuilding for example, considerable care must be exercised in the control of welding sequences if high residual stresses are to be avoided. It is likewise recognized that during the press of war production the control of such sequences was frequently subordinated to increased rate of production. Moreover, faulty welding produces conditions such as porosity, slag inclusions, and undercutting, which in themselves produce centers of stress concentration and notches that might well be the starting points of cracks, especially when such defects occur in regions of high residual and imposed stresses. Consequently faulty welding was undoubtedly a contributing factor in the fracture of some of the structures.

But there must be more to it than that. The question of why a material that is ductile when tested as a standard tensile coupon, fractures without appreciable elongation in a composite structure has not been answered. Possibly the stress condition or the welding can be blamed for producing notches and high stress concentrations, but if the material is ductile why doesn't it flow until the high stress is relieved and then go on about a normal existence? This behavior has been characteristic of steel in the past, and our attitude toward the design of structures for tensile loading has been built up on this background of experience. Is it possible that the steel supplied under wartime pressure is inferior in quality even though it meets the same acceptance specifications? Or is it possible that the welding process acts adversely on the steel and leaves it in a brittle condition?

BRITTLENESS INVESTIGATED

Although a great deal of research has been done in many laboratories under the direction of the War Metallurgy Committee on various phases of the problem of the brittle behavior of plating, the present discussion is confined to a brief statement of the work carried on at the David Taylor Model Basin.

The fact that cracks propagate rapidly with small absorption of energy, and small reduction in the area of the plating, indicates that the material has a high notch sensitivity. Impact tests made with both keyhole-notched and V-notched specimens on material taken from fractured plates showed very low values of energy absorption at the temperatures at which the structures fractured. This immediately indicated that the notch sensitivity of the material was a contributing factor in the propagation of a crack once it was initiated.

Two typical Charpy impact curves of energy absorption plotted against temperature are shown in Fig. 1. It will be observed that for the higher temperatures the energy absorption is high, whereas for the lower temperatures the energy absorption is low. Moreover, the transition from high to low energy absorption is very abrupt. An examination of the Charpy specimens after test reveals that the specimens that absorbed

high values of energy exhibited a considerable amount of ductility, whereas those below the transition temperature, which absorbed little

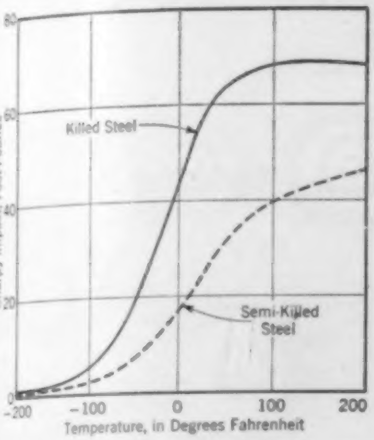


FIG. 1. TYPICAL CHARPY IMPACT CURVES

energy, showed no signs of ductility. In fact, the transition temperature can be determined about as well from a visual inspection of the specimens as from a curve of energy absorption plotted against temperature.

Do the same conditions exist for large structures under static loads? If a small crack or discontinuity exists in a steel plate, will it propagate rapidly with little energy absorption at low temperatures, but slowly with high energy absorption at high temperatures, when the structure is pulled under static load? Is there an abrupt transition temperature from low energy absorption to high energy absorption as shown by Charpy impact data? If so, can impact tests be used to show at what temperatures a given material will behave in a brittle manner and at what temperatures it can be depended upon to have adequate ductility to prevent the formation and propagation of cracks?

To answer these questions, tensile plate specimens similar to those shown in Fig. 2 were pulled to rupture at different temperatures at the David Taylor Model Basin. It will be observed that these specimens had an artificial notch or crack transverse to the direction of loading. Notches with different degrees of sharpness were used, varying from natural fatigue cracks to drilled holes $2^{1}/_{2}$ in. in diameter.

Similar tests on plates of other types of steel, which showed lower transition temperatures by Charpy impact tests, likewise showed lower transition temperatures from ductile to brittle fracture. This presents convincing evidence that Charpy impact data can be of real value in screening material that may perform in a brittle manner under tensile loading. If this is true, some specification of safe impact values at the lowest working temperature should be included in the selection of steel that is to be used for carrying appreciable tensile loading.

THE COMPRESSIVE YIELD STRENGTH

A second mechanical property which is seldom considered in the design of engineering structures is the compressive yield strength of the material. As is well known, the compressive strength of columns, plates, shells, and other engineering structures depends on the elastic modulus in compression, which becomes zero at the compressive yield point. Fortunately, the elastic modulus in compression is in sufficient agreement with the elastic modulus in tension so that the two may be used interchangeably for designs where the buckling strength is well below the yield strength. However, it may be unsafe to use the tensile yield strength and the compressive yield strength interchangeably.

In general, the compressive yield strength may not differ appreciably from the lower tensile yield strength; and with the present high factors of safety used in most land structures, engineers can continue to use the lower tensile yield strength for the design of structures under compressive loading. However, the fact should not be lost sight of that in so doing one mechanical property is used as the basis for procurement whereas a different mechanical property is used as the basis for design. Structures should not be designed for high compressive stresses with a low factor of safety without definite knowledge of the compressive yield strength of the material used in the design.

It is hoped that in the near future sufficient data will be accumulated so that an accurate appraisal of the situation can be made; acceptance specifications for materials to be used under high compressive stresses can then be modified if required.

TWO ADDITIONAL ACCEPTANCE TESTS

The testing of coupons in compression, especially to determine compressive yield strength only, is a comparatively simple matter and has been put on a production basis in some laboratories. The requirement of such tests for procurement of materials would not impose much of a hardship.

However, the picture is changed if we are to require sufficient impact-test data to establish curves of energy plotted against temperature similar to those shown in Fig. 1. Not only is the acquisition of such data time consuming and costly, but a well-controlled technique must be used if the data obtained from different laboratories on the same material are to be consistent.

Moreover, data obtained at one or two convenient temperatures cannot be safely extrapolated to lower temperatures. The most convenient single low temperature to use is the temperature of melting ice; but impact data obtained at this temperature cannot be used to predict the notch sensitivity of the same material at a temperature a few degrees lower because of the relatively steep slope of some of the curves in the region of the transition temperature.

The only safe single temperature that can be used is a temperature below the lowest working temperature of the structure. Such a single temperature for American structures might be chosen as −40 F. For structures that are used at room temperature, the temperature of melting ice would be satisfactory.

It might seem revolutionary and unnecessarily expensive to require impact data for acceptance of materials to be used under tensile loading. However, it should be pointed out that the requirement of tensile-test data was once considered even more revolutionary and required much more expensive testing equipment. However, today the use of tensile-test data as the basis for procurement of steel is accepted as a matter of fact. All structural and

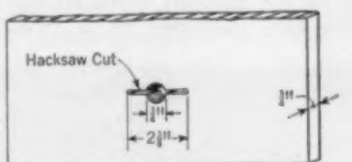


FIG. 2. TENSILE TEST SPECIMEN

inspection laboratories are equipped with modern tensile testing machines, and the testing techniques have been so well developed that permanent, reproducible, autographic records can be obtained rapidly and cheaply.

It is believed that similar progress can be made in securing impact data suitable for acceptance purposes. Once standard specifications are established, the initiative and ingenuity of the engineers called upon to make the tests can be counted upon to devise simple, reproducible, and inexpensive methods of obtaining the required data.

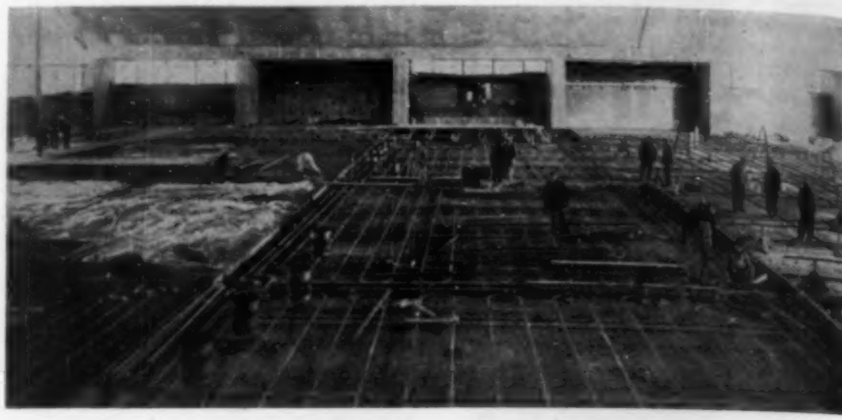
Radiant Heating Built Into Concrete Hangar

New Reinforced Concrete Structure to House General Electric Flight Test Laboratory

By Francis R. MacLeay, M. ASCE

Chief Engineer, Corbetta Construction Company, New York, N.Y.

So that test work on the floor of General Electric's new flight laboratory would not be disrupted by widely varying temperatures, radiant heating pipes were placed in the concrete floor of the unique hangar. Construction of the ribbed shell utilized sliding forms and transit-mixed concrete. The clear span of the hangar is 160 ft; it is large enough to hold four B-24 bombers. The location is the Schenectady, N.Y., County Airport.



Piping in Place Before Floor Was Poured

To permit delicate tests on aircraft to proceed despite weather, a novel heating system was installed in the new General Electric Flight Test Laboratory in Schenectady, New York. The system features floor heating coils composed of over four miles of wrought-iron pipe embedded in the concrete floor slab. Thus the working area of the huge test building, the space at the floor level, is kept warm at all times, even when the huge doors, 160 ft by 35 ft, are opened in the winter.

The laboratory, which was dedicated recently, is housed in a reinforced-concrete, ribbed-shell hangar, whose dimensions permit housing four planes of B-24 bomber size. At one side of the hangar, work rooms and offices are provided in a two-floor lean-to, also of reinforced concrete framing. Clear dimensions of the hangar area are 175 ft in length by 160 ft in width. At the center of the span the inside height is 45 ft.

The heating coils and the floor slab were installed after the hangar ribs and shell were in place. Special attention to subgrade and concrete placing was necessary to assure proper slopes in the coils. The entire area of the hangar floor was graded to subgrade with a blade grader, then compacted by using a 10-ton roller, after which a compacted fill of sand and gravel 12 in. thick was placed. A 2-in. thickness of concrete was screeded to a true level grade and checked by surveyor's level.

To maintain a constant slope of 1 in. per 100 ft in the pipes, they were supported on steel angle frames placed on the concrete leveling course, with the angle legs projecting through the reinforcing mesh, which was placed before the piping. The $1^1/_2$-in. pipes were spaced 18 in. on centers except for the 35-ft strip next to the hangar doors, and around the north and west walls, where the spacing was 12 in. on centers to make up for the heat loss through the doors and walls. The distance between the top of the coils and the finished surface varied from $1^1/_2$ to 3 in. Heating efficiency is not affected by a few inches of concrete over the coils, since the concrete acts as a heat distributor.

Interior of Hangar with Main Doors Open, Tail-Gate Closed

Completed Hangar at Schenectady, New York

The one-course floor slab was laid in panels 35 ft by 40 ft in size, checkerboard fashion. Alternate panels were then filled in. Thus the shrinkage was reduced, as alternate panels took the initial shrinkage before the intervening panels were poured. Expansion joints of preformed asphalt type were placed on all sides of each panel. Each pipe crossing the expansion joint was bent in a double ogee curve, for expansion of the pipe under heat, and the curve was cased in "Air-Cell" pipe covering to keep the concrete from the pipe and allow freedom of movement. Concrete for the 8-in. floor was mixed with standard portland cement and the surface wood-floated.

Hot water for the heating system is furnished by an oil-fired steam heating boiler. Generated steam passes through an exchanger, heating the water that is circulated through the floor coils.

The hangar is of reinforced concrete, following the ribbed shell design developed shortly before World War II and used at a number of military airfields. The main arch ribs carry the thin barrel arch, which is but $3^1/_2$ in. thick at the crown.

Timber forms were constructed on the job and mounted on railroad tracks so that when one section was complete they could be moved ahead for the next section. Screw jacks raised the forms into place, where they were blocked during pouring of the concrete.

Posts for the falsework were 6 by 6 in., braced in all directions by 2 by 6-in. members. Joints were ring connected. Sheeting for the forms was carried on trusses supported by this system of posts. The screw jacks for raising the forms were located between the posts and the form trusses. The whole assembly was mounted on cast-iron wheels, and motive power for moving the forms was supplied by crane load line.

The operation of stripping by means of lowering the form, moving to a new location, and jacking to correct elevation ready to receive the reinforcing bars and mesh, required three hours of time. Steel bars, delivered on the job cut and bent, were lifted onto the forms by cranes. It required four days to prepare for the concrete.

Concrete for the structure was delivered by ready-mix trucks shuttling between the job site and the batching plant at Scotia, N.Y., a distance of $1^1/_2$ miles. Footings for the arch ribs were poured first, bearing on a good shale, which gave adequate support so that ties for the arches were not needed. The movable arch centering was erected for a 70-ft panel section.

Concrete was deposited in concrete buckets by the mixer trucks, hoisted by crane and dumped into buggies standing on a runway supported on the moving forms. Rate of pouring and consistency of the mix were planned so that external arch forms, even at the springing line, were not needed. The roof surface was wood floated and covered with board insulation and roofing. Each pour was continuous until the entire panel was complete; thus about 340 cu yd were placed in an average period of 7 hours.

Three or four days were allowed for the concrete to reach its initia strength of 2,500 lb per sq in. before the forms were decentered. Thus each complete cycle of preparing forms and concreting required 14 days in all.

The laboratory was constructed for the General Electric Company by the Corbetta Construction Company of New York, N.Y. Consultants on the design of the hangar were Marcus T. Reynolds (architect), and Roberts and Schaffer (structural). The structure was built under the direction of Frederic D. Foss, M. ASCE, projects manager. Fred Narr was superintendent.

Section of Movable Forms for Hangar Construction

Stability of Runway Soils Determined by Ground-Water Vapor

By H. H. Houk, M. ASCE
Consulting Engineer, Washington, D.C.

BROKEN, sunken, or pumping runway pavements are costly to maintain and repair. Yet these outward signs of unstable base courses can be avoided if proper attention is paid by the designing engineer to ground water in the vapor phase in the soil under the pavement. Of course the expert handling of water in all its phases is of prime importance. However, the statement that drainage is first, second, and third in importance has appeared so frequently in engineering literature that there is a tendency to attribute all pavement failures to defective drainage. It is therefore necessary to stress the following facts: (1) the term drainage covers only the artificial removal of drainable water; (2) all forms of water are not drainable; and (3) undrainable forms are frequently most destructive to the pavement structure.

Attempts to follow literally the recipe, "drainage, drainage, and more drainage," often lead engineers to employ types of construction that foster the movement of water in the liquid and vapor phases. It is impractical, if not impossible, to overcome the weakening effects of this either by drainage or by reinforcement of the pavement.

MUCH UNDERDRAINAGE USELESS

For many years engineers have relied upon surface drainage supplemented by subdrainage for the solution of all problems of excess moisture. Surface drainage is always a necessity, and it should be positive and simple. Effective subdrainage is frequently necessary to intercept or remove surplus free subsurface ground water that would otherwise flow, soak, or rise into the subgrade soil. Unfortunately many expensive underdrainage systems have been installed in soils where they do not fulfill their intended purpose (Fig. 1). This is the case when the soil has no free water table. Such installations are still encountered, although investigation and research have long since disclosed the nature of capillary moisture. It is now generally recognized that water in this state cannot be drained.

Prevention of the visible entrance of water is not a cure for all soil-support infirmities. To avoid and correct moisture damage, one must first ascertain where the moisture comes from and how it travels. The soil zone most important to the paving engineer, the zone between the subgrade and the free water table, is still in some respects a "no man's land." Many unfounded opinions persist as to the true cause of loss of soil load-capacity and the distress and progressive failure of innumerable pavements on soils of high capillarity, variously classed as "poor," "unfavorable," "adverse," "impervious," "plastic," "clayey," "waxy," and so forth.

Large sums and enormous effort have been expended on bearing tests and simulated traffic tests to determine the load capacity of soils in their natural, compacted, and weakened conditions. These overlook the fact that densification is but the first and most obvious step in the control of undrainable moisture, through reduction in pore size and isolation of pore spaces.

Soil is a porous medium composed of solid particles and pore space. The ratio of the intergranular space to the total volume of a given soil mass is a function of the gradation of the soil particles and their arrangement in the mass. The size of the pores is dependent upon the nature, size, arrangement, and compaction of the soil particles. Retention of water in a soil and movements of water and air into and through it, depend in a large measure on the amount of the pores and their size distribution and interconnections. For instance, a granular clay may have non-capillary pores between the granules and capillary pores within the granules, and in this state it may not only permit ready movement, but also hold much water tightly.

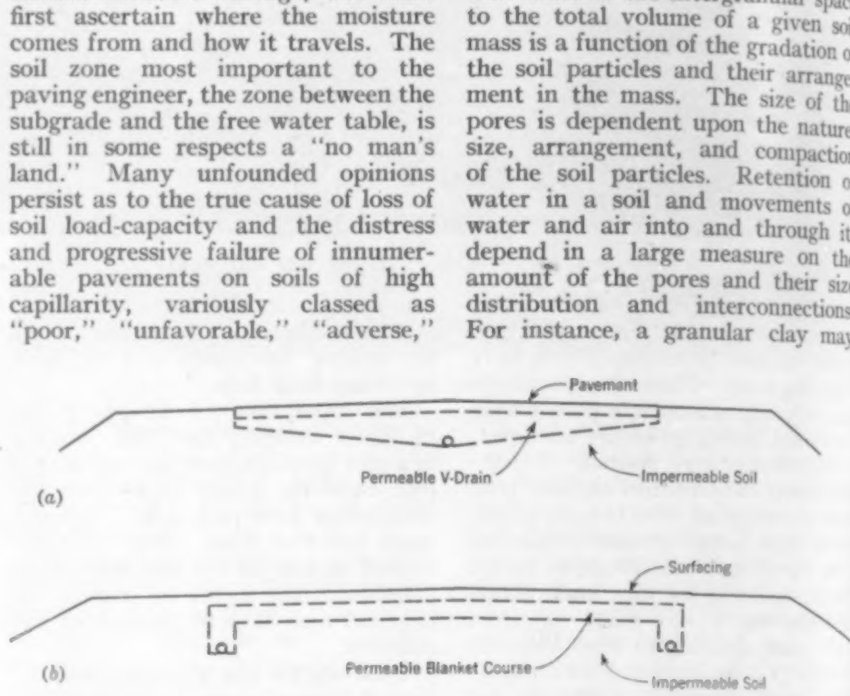


Fig. 1. Well-Meant Designs Often Provide Permeable Reservoirs Which Feed Water into the Subgrade. Displaced Soil Works up Through Pores and Out Cracks and Joints

VAPOR IN SOIL MOVES

All soils have an air and gas capacity, and a water capacity. The pores of every fine-grained soil are partly filled with air plus soil gas, and partly with water. The water, in liquid, solid, and gaseous form, can exist in equilibrium and in contact.

when the vapor pressure equals 0.459 cm (Hg) and the temperature 0.0098 C.

Moisture may move upward in the soil in the liquid or vapor states. A waterproof pavement decreases the amount of water lost to the atmosphere but it does not stop the process of evaporation. When water is in a space it does not fill, it evaporates until all the water has been converted into vapor, or until a vapor pressure balance has been reached. At that point, evaporation and recondensation go on at the same rate.

Vapor moves from moist soil to drier soil until the vapor pressures are equal. Likewise the flow of capillary water from moist soil continues to replenish water evaporated if films are present and continuous. Water moves not only from free water tables but also from cool soils to warmer soils containing less moisture, and from points of higher pressure to points of lower pressure.

Results of Temperature Changes

There is a definite maximum vapor pressure at each temperature. The quantity of vapor is defined by the gaseous pressure it exercises and the space it occupies. If water is present when the temperature of saturated soil air increases, the concentration of water vapor increases and the pressure rises. If the temperature drops, a part of the contained vapor condenses into free water.

Ordinarily soil air, particularly under a wide confining pavement, is saturated. A slight change in the temperature instantly upsets the state of equilibrium. When there are large spaces under rigid pavements, or large connected pores in the surface or intermediate courses, the accumulations of free water become critical. The liquid content of the course is increased and the free water collects in depressions, basins, and water pockets. With the lapse of time it even emerges from fractures and joints, especially during large and frequent temperature variations, when the ground-water table or capillary fringe is high. Drainage methods may partially remove such accumulations but will not stop the activity.

Such accumulations are the most obvious symptoms of water vapor movement. Its action disintegrates and destroys pavements. Generally this weakening of soil support, breaking up of surfaces, and pumping of pavements is more pronounced in the spring and early summer in the Eastern United States. Distress symptoms of such ills are not exhibited in midwinter because movements upward, changes in phase, and differences in soil temperature are much smaller. Many spring break-ups in soils that are not definitely frost-heaving are erroneously attributed to frost action.

Insulating Courses Designed

On all soils appreciably affected by changes in water content, insulation courses should be designed and constructed with the prime objective of controlling water movement. Unless the free water can condense in such courses, and flow back by gravity into the underlying subgrade soil without detrimental weakening, vapor movement and capillary movement must be limited.

With the enormous increase in design wheel loads and the demand for more and better traffic ways, it is imperative that engineers develop and hold the maximum soil load capacity. To do this, they must hold moisture movements within definite limits. Fortunately experiments and experience indicate that this can be done by limiting the size of pores and the amount of interconnection in soil transition layers between the subgrade and pavement. Selected top-soil and sand clay have long proved effective as insulating layers under pavements. Certain crushed limestones and blast-furnace slags, with their cementitious fragmentary fines, are practically impermeable if properly placed. Similarly, natural and synthetic gravel mixtures with stable cementitious fines are impermeable to a high degree.

In this connection, the definition of clay is unfortunate in that it carries no restriction as to chemical or mineralogical character. The unsatisfactory behavior of courses in which the fines were clay with unstable characteristics and insufficient binding qualities has frequently led to over-limitation of fines and excessive pore space. Adequate fines must be present in the layer as placed and consolidated to insure the required degree of impermeability.

Paving courses restrict surface infiltration but they do not long restrict vapor movement. Dependable design criteria have been developed for known soil load capacities. However, assumption of a value for weakened capacity, which may progressively increase during the years of service, results in overdesign without a real factor of safety.

Vapor movement can be controlled through the active zone of the soil profile, and maximum load capacity developed and held by the proper selection, design, and construction of intermediate insulating or restrictive courses (Fig. 2).

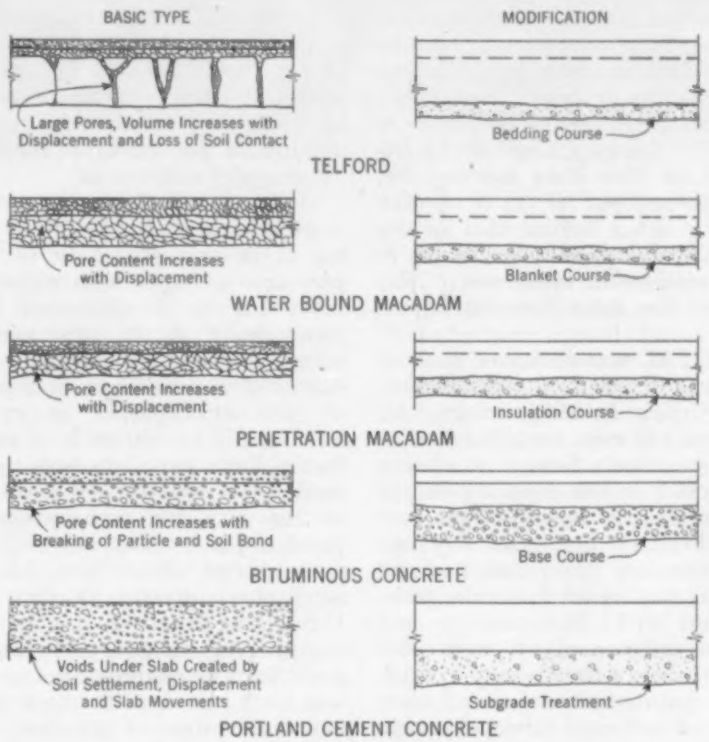


Fig. 2. Developments in the Use of Impermeable Layers Under Pavements to Correct Design and Prevent Break-ups Caused by Movement of Ground-Water Vapor

Fuel and Fertilizer from Sewage—Aim of German Treatment Plants

By A. J. Fischer, Assoc. M. ASCE
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Sewage treatment plants in Germany during the war years were operated primarily for the production of digester-gas fuel and for the recovery of other valuable constituents from the wastes. This situation was disclosed by an inspection by American engineers during 1945. Reporting the survey to the ASCE Sanitary Engineering Division at its New York meeting, Dr. Fischer pointed out the lag of German sanitary practice behind that in the United States, especially in the use of modern mechanical equipment. This article has been taken from that report.

A total war economy, such as was imposed on Germany beginning in 1938, affected all operations and even curtailed sewage disposal practice. Sewage treatment had no place in the economy except where it directly benefited the war effort. Primary emphasis was put on the recovery from domestic and industrial wastes of minerals, fertilizers, and fuel. Maintenance and repair of existing plants were neglected because of the scarcity of critical and substitute materials, while the lack of sufficient labor adversely affected routine operation. However, during the period from 1938 to 1945 about 235 new or expanded plants were built, most of them at military establishments or industrial plants.

Of particular note was the development of the use of digester gas as a motor-vehicle fuel. This was made necessary by the high cost and scarcity of gasoline. Rather than use the gas for sludge heating or for power generation at the sewage plant, they chose to use coal and electrical energy for these purposes in order to make the maximum amount of gas available for driving automobiles and trucks.

Common practice in Germany was to process the stored gas by compressing it in two stages to 14 atmospheres, washing it with water to remove carbon dioxide, and further compressing it in two additional stages to 350 atmospheres. It was delivered to consumers at a pressure of 200 atmospheres in cylinders holding 350 to 560 cu ft of gas. In Berlin large cylinders holding 2,500 cu ft of gas were trucked to the center of the city for distribution. The purified gas contains 90–94% methane. About 135 cu ft of this gas at atmospheric pressure is equal to one U.S. gallon of gasoline. The cost of compressing the gas, excluding plant amortization charges and so forth, was said to be equal to about 10 cents per U.S. gallon of gasoline. Fixed charges on equipment and facilities would about triple this cost for moderate-sized plants.

Industrial Wastes

In the industrial-waste treatment field, unit operations and equipment for chemical and biological treatment methods were similar to those used in the United States. Wherever possible, the recovery of valuable constituents in the wastes was stressed. This applied particularly to phenol, iron, and copper wastes.

In the treatment of TNT wastes, stage neutralization by lime with automatic pH-value control was standard practice. Cyanide wastes were either treated with lime and chlorine or were aerated after acidification and then neutralized with lime. Chromate wastes were precipitated by means of barium salts in alkaline solution.

For the rough treatment of phenolic wastes, benzol extraction was in general use. However, after the start of the war a few "Phenolsolvan" plants were constructed. In this method a mixture of esters of aliphatic alcohols is used as the solvent medium. The chief advantage of this method is that a very low percentage of solvent is required.

Where solvent extraction methods are used, the residual phenol content of the waste liquor generally runs about 100 to 200 ppm. To obtain further reductions, biological treatment methods are required. Successful treatment on trickling filters at a dosing rate of 2.6 mgd on a bed 6 ft deep has been reported. Also of interest was a method of treating a waste containing as high as 10,000 ppm of phenols by the activated sludge process with the aid of nutrient salts containing nitrogen and phosphorus.

Copper-bearing wastes were treated in a small plant wherein the waste was mixed with fine iron filings and settled. The settled effluent was then passed through a contact bed of iron turnings. Complete removal of 335 ppm of copper was said to be obtained by this process. The precipitated copper was recovered from the sludge.

Pickling-liquor treatment methods used recently in the Ruhr District involve the removal of ferrous sulfate by crystallization. In this process, fresh acid is added to the spent liquor to increase the acid concentration from 2–5% up to 25%. This solution is then cooled from 60 C to 15 C in order to separate out the iron

Niersverband Chemical Treatment Plant Uses Activated Sludge Process

salt. By this method the loss of acid is reduced to 10–15%.

Unit operations in the newer plants closely parallel those used in the United States. An interesting difference, however, is in the complexity of the German designs. This applies both to concrete work and to mechanical equipment. Storm-water flows are treated by settling tanks or rotary screens to a limited extent. The screens used are of a self-cleaning type wherein the solids are continuously carried by a minor flow of liquid to that portion of the flow being conveyed to the treatment plant. Bar screens are generally mechanically cleaned, but grinding of screenings is rare. The trend toward grinding is, however, increasing.

Grit removal, where practiced, is generally by means of plain longitudinal tanks. These grit channels are cleaned by hand or by the use of bucket elevators which may be arranged to travel the length of the channels. Upflow and tangential-feed circular grit chambers are used to a limited extent. In both designs the settled grit is removed by an air lift. In a few large plants the grit is removed mechanically and washed as in the United States.

Settling-tank designs are characterized by the use of large sludge hoppers. In general, primary tanks are mechanically cleaned, Mieder-type mechanisms being used exclusively for rectangular tanks. For round tanks both pitched-blade and spiral-scraper mechanisms are employed.

COMPLICATED INLETS

In some round units, very complicated inlet and outlet designs are used. Typical examples are the Pruss tanks at Hamm and Alte-Emscher, where the effluent is taken off through a series of telescoping outlets arranged around the tank periphery. The top of each outlet is held at a predetermined distance below the liquid level by floats. This design was adopted in order to insure even peripheral overflow discharge despite uneven tank settlement after construction.

Plain Dortmund tanks are used to a considerable extent for secondary settling even in large plants. In a large activated sludge plant being proposed for Berlin, plain hopper-bottomed tanks were planned for both primary and secondary settling. The designing engineers felt that because of the very long sewer carrying the sewage to the treatment plant, considerable ice would form in the treatment tanks during the winter months. For this reason, the use of any mechanical equipment was considered hazardous.

An activated-sludge plant being designed by Dr. Imhoff to treat the sewage from a population of 1,300,000 in the city of Berlin had the interesting feature of being laid out in three separate groups, each of which in turn was divided into three sections. Each section could be operated independently as a separate plant. It was contemplated that the treatment in one or more sections would be carried to a high degree of nitrification and the final effluent recirculated to the raw sewage entering all three plant groups. In this manner it was thought that the septic sewage could be made more amenable to treatment, and odors minimized. This plant was to be mechanically equipped throughout.

A number of enclosed filters of the forced down-draft type, dosed at three to four times the conventional rate, have been constructed, chiefly in the Ruhr District. Two units of this type were constructed at Iserlohn to replace activated sludge using Imhoff aerators. Others were at Heiligenhaus and Soest. From visual observation, it was judged that results at the Iserlohn and Heiligenhaus plants were not impressive. Fly and odor nuisances outside the filters were, however, absent. At Soest, short-period activated sludge treatment followed the enclosed filters. Good results were reported from this plant, but when visited, it was being operated at greatly reduced capacity so that observation under normal operating conditions was not possible.

Contact aerators have completely disappeared from Germany as a means of secondary treatment because they cannot compete economically in operating costs with acti-

DIGESTER GAS DISTRIBUTED IN PRESSURE CYLINDERS

SETTLING TANK OF THE ESCHENTRUTH TNT WASTE TREATMENT PLANT

ENCLOSED AERATED FILTER AT ISERLOHN PLANT, DOSED AT THREE TO FOUR TIMES CONVENTIONAL RATE

vated sludge or trickling filters. The plant at Hattingen was the last of its type. It was replaced by activated sludge in 1936. This plant, incidentally, was the only one of its kind seen that was in full operation, and was one of the few seen that was turning out what could be considered a good effluent.

Although fish ponds are used at present to a considerable extent for effluent treatment, they are falling into disuse. Their use in future designs is questioned. Likewise sewage farms, which were extensively favored during the Nazi regime, are regarded as temporary makeshifts and will undoubtedly be discarded in favor of more orthodox treatment methods when construction of new plants is resumed. Plans for the further use of activated sludge treatment at Berlin illustrate this trend.

Owing to the lack of chlorine gas, chlorination was not practiced at any plant during the war. Even before the war, the use of chlorine was rare. Chemical treatment was also rare because of the high cost of chemicals.

The outstanding chemical treatment plant was that of the Niersverband, where carbon dioxide and iron filings are used for the preliminary treatment of strong sewage ahead of activated sludge treatment. This plant was designed to treat sewage from an equivalent population of 800,000, three-quarters of which is from industrial establishments. The process used comprises carbonation of the sewage with stack gases, mixing and flocculation with reduced iron sludge, settling, contacting the clarified sewage with iron filings, and then activating in two stages. According to Dr. Jung, who originated this process, the B.O.D. of the sewage is reduced from 1,400 ppm down to 10–20 ppm by this method. The biological reduction and reuse of the iron sludge were said to decrease the coagulant requirements to 15 ppm of iron.

Except in a number of plants in the Ruhr District where industrial wastes predominate and the settled sludge is lagooned, raw sludges are generally digested. Practically all digestion tanks are heated and are provided with gas-collection facilities. The use of rotating heating coils for better heat transmission is common. External raw-sludge pre-heaters are used to some extent, as are removable internal heating coils. Digester-stirring or rotary sludge-distribution devices are widely used. Stage digestion is used to a considerable extent.

A common design of digestion tanks involves the use of conical roof and floor construction in order to facilitate the breaking down of scum and the removal of digested sludge. Earth banking of tanks is rare, cork or air-cell insulation being used to conserve heat.

The inspection tour was made under the sponsorship of the Foreign Economic Administration through the Technical Industrial Intelligence Committee (TIIC). Members of the investigating group were A. E. Gorman, A. V. Sheridan, Lt. Col. J. J. Gilbert, and A. J. Fischer, all members of ASCE. Approximately sixty objectives were visited, as shown in Fig. 1. These included plants, consulting engineers, equipment manufacturers, and operators. In general, German practice, as judged by this inspection, lagged considerably behind that in the United States with regard to both treatment processes and use of equipment.

FIG. 1. ROUTE OF GROUP INVESTIGATING GERMAN SANITARY WORKS

40/50 penetration asphalt cem

Uncompacted Mass Asphalt Paving for River Banks and Levees

By A. B. Pickett

Lieutenant Colonel, Corps of Engineers, Assistant to the District Engineer, New Orleans District, New Orleans, La.

UNDER the direction of the President of the Mississippi River Commission, all three Engineer Districts in the Lower Mississippi Valley Division have been concerned with the problem of protecting that part of the river bank exposed above mean low water from attack by river currents, driftwood, and erosion by rainwash. This upper-bank protection, or paving, is generally installed at locations where subaqueous revetments have been placed. Various means have been employed to pave these upper banks.

In the New Orleans District, the levees are very close to the river bank and are subject to attack by wavewash and current in exposed locations. They also require some type of protection during periods of high water. Therefore their river-side slopes are paved. Riprap, concrete, brick, and compacted sheet asphalt have all been used for this work. In line with the policy of the Corps of Engineers to strive continually to improve methods and reduce costs, a new type of protective covering or paving has been developed for this specific use.

The paving of a river bank or levee slope is often confused with street and highway paving, but the problem might be said to be just the opposite. There is no traffic load to design for; and high density, stability, alinement, and surface finish, all so necessary in road construction, lose their importance in this type of work. The fact that field conditions make it impractical to compact or otherwise prepare the subbase, as might be required for a road, must also be taken into consideration. A pavement that will flex under its own weight, adhere tightly to the subgrade without crawling and, if possible, also be sufficiently porous to bleed the ground water, while at the same time being heavy and rugged enough to withstand various types of attack, will have the desired characteristics.

Test Strip Laid

With these specifications in mind, the New Orleans District laid a test strip of mass asphalt as upper-bank paving in Avondale Bend, just above New Orleans, in July and August 1943. The mixture used consisted of approximately 55% washed concrete gravel, 38% washed sand, and 7% of 40/50 penetration asphalt cement. It is interesting to note that no limestone dust or other filler was included in the mixture. The mass asphalt was mixed in a batch-type mixer at 300 to 350 F and placed with a 1-cu yd clamshell bucket at 275 to 325 F. The bank had been graded to a slope of 1 vertical to 3 horizontal, and the subgrade was given no particular preparation other than removal of drift and smoothing of major irregularities. As the hot mix was dumped on the bank, it was raked down to an average thickness of 6 in. Actually it flattened out on being dumped from the bucket and required only a minimum amount of raking. The surface was left with a raked or luted finish, and was not rolled or compacted in any way. This strip of pavement has been under continuous wavewash attack and has been completely submerged by over-bank stages a number of times. It also passed through a major flood in 1945. A recent examination after $2^1/_2$ years of service showed it to be in excellent condition and revealed no sign of failure or deterioration.

Used to Stabilize Riprap

Shortly after this experimental strip was placed, it was decided to employ this same type of mass asphalt to cover and hold in place a

Placing Hot Asphalt Paving on River Bank with Clamshell Derrick

...so as to relieve the hydro-

LEVEE PAVING BEING PLACED OVER A PREPARED SLOPE

heavy blanket of stone riprap and concrete blocks that had been placed on Warfield Point, a control point on the Mississippi River near Greenville, Miss. This location is subjected to severe current attack; at times the velocity exceeds 8 miles per hour. The work was carried on during December 1943 and January 1944 under very adverse weather conditions, with the temperature below freezing a large part of the time. A mixture similar to that used at Avondale Bend was employed until the gravel supply was cut off about midway of the job. A mixture of straight bar-run sand and 7% asphalt cement was then used to complete the work. Experience has indicated that both these mixes perform about the same.

GOOD RESULTS OBTAINED

The hot mixture was dumped with a clamshell bucket onto the riprap and flowed between, around, and over it to bind the whole into a solid mass. The asphalt mixture was applied at the rate of approximately $4^1/_3$ tons per square (of 100 sq ft). A total of 1,766 squares were covered at this location. The work has withstood the attack of high stages a number of times, as well as the flood of 1945. An examination made in November 1945 showed it to be in very good condition and serving the purpose for which it was intended.

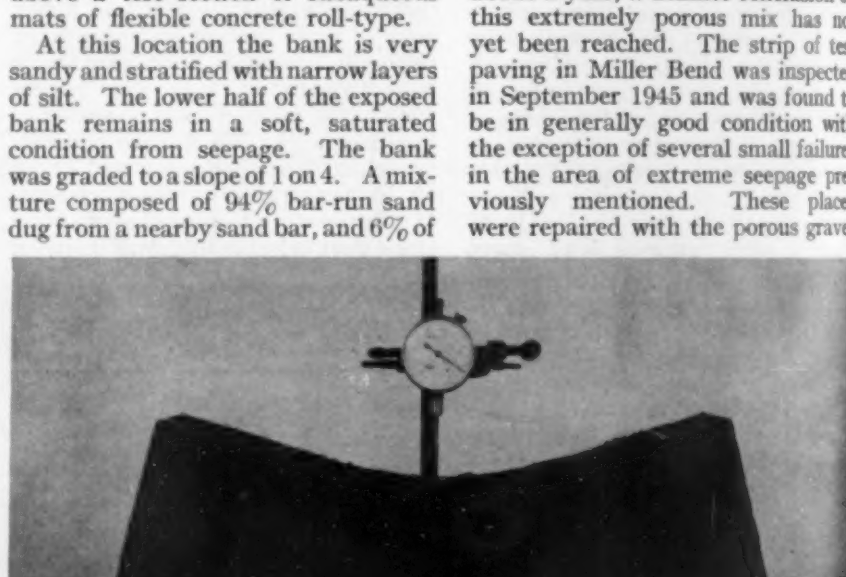
To continue the work of testing and developing this type of paving, a strip of upper bank approximately 800 ft long by 100 ft wide (800 squares) was laid in January 1945, at Miller Bend near Greenville, Miss. This upper-bank paving was placed above a test section of subaqueous mats of flexible concrete roll-type.

At this location the bank is very sandy and stratified with narrow layers of silt. The lower half of the exposed bank remains in a soft, saturated condition from seepage. The bank was graded to a slope of 1 on 4. A mixture composed of 94% bar-run sand dug from a nearby sand bar, and 6% of 40/50 penetration asphalt cement was dumped in place with a clamshell bucket and raked to an even surface. The average thickness was 6 in. and the pavement was not compacted in any way. It was noted later that the seepage water was percolating slowly through the porous mix, as had been expected.

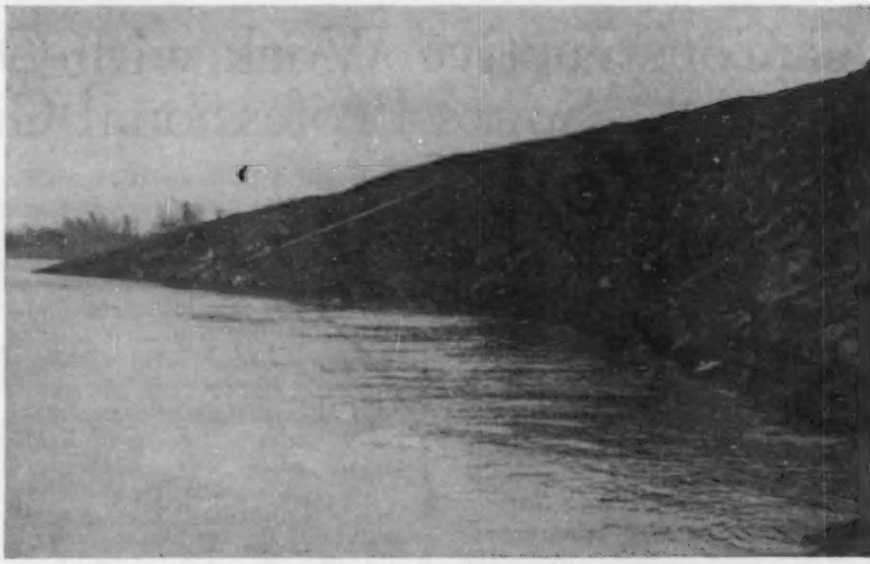
METHOD FOR EXTREME SEEPAGE

Since this bank at Miller Bend was paved, experience has shown that the coarse sand mix is sufficiently porous to permit slow seepage, but that where the water is flowing in a manner similar to small springs, even greater porosity is desirable. To meet this latter condition, a mixture composed of approximately 72% gravel (passing a $^3/_4$-in. mesh and retained on a No. 4 sieve), 23% bar sand, and 5% of 85/100 penetration asphalt cement has been placed in horizontal bands about 5 ft wide at locations where extreme seepage has been encountered. This pavement appears to bleed the water freely without permitting the escape of any of the fine sand or silt in the subgrade, very much as would a filter.

As this section has been in use only about a year, a definite conclusion on this extremely porous mix has not yet been reached. The strip of test paving in Miller Bend was inspected in September 1945 and was found to be in generally good condition with the exception of several small failures in the area of extreme seepage previously mentioned. These places were repaired with the porous gravel



SPECIMEN OF UNCOMPACTED ASPHALT PAVING ON FLEXIBILITY-TEST APPARATUS



RIPRAP SUCCESSFULLY HELD IN PLACE BY ASPHALT BLANKET

mixture so as to relieve the hydrostatic pressure. The job is being observed periodically to evaluate the performance of this mix when used under such conditions.

CONSTRUCTION ADVANTAGES

The test jobs described indicate that this new type of mass asphalt paving, in addition to the qualities of ruggedness, flexibility, porosity, and stability required in a bank-paving material, also offers a number of construction advantages, as follows:

1. Approximately 95% of the material in the mixture is produced locally from the river.
2. The mixture can be placed and spread quickly with a small crew using ordinary construction equipment.
3. No forms, screeds, or expansion joints are needed.
4. The work lends itself to award by contract.

Up to this point the development work had been carried on by field forces, but it was felt that the laboratory could now be of assistance. The U.S. Waterways Experiment Station at Vicksburg, Miss., was accordingly requested to make a study, the general objectives of which were to determine the effects of:

1. Mixing temperature on flexibility.
2. Asphalt cement content on flexibility and porosity.
3. Different penetration asphalts on flexibility.

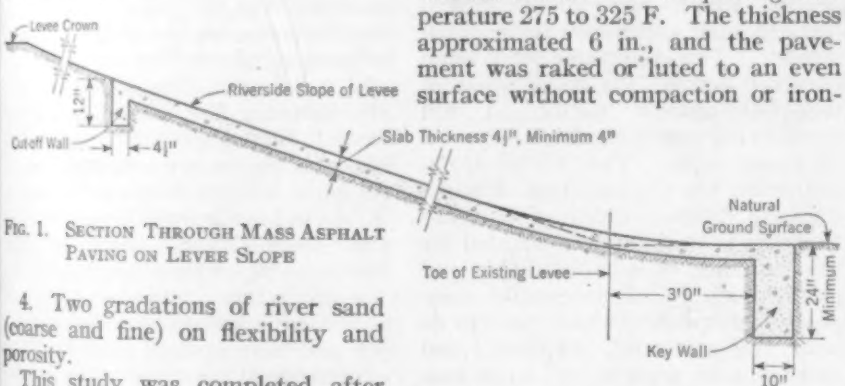


FIG. 1. SECTION THROUGH MASS ASPHALT PAVING ON LEVEE SLOPE

4. Two gradations of river sand (coarse and fine) on flexibility and porosity.

This study was completed after several months of work and the results were given in the report of July 15, 1945. The information furnished in this report has been used more or less as a handbook by the field forces and has proved of real value in adjusting the mix at each location to secure the best results from materials locally available.

The initial development stage having been completed, and in view of the facts established by the report of the U.S. Waterways Experiment Station, the President of the Mississippi River Commission decided to adopt this method of paving for the upper banks in the Vicksburg and New Orleans Districts. During the latter part of 1945, a total of 10,000 squares of mass-asphalt upper-bank paving was placed as protection above the subaqueous concrete mattresses previously laid. This work involved four locations—Miller Bend, Milliken Bend, Goodrich Bend, and Kempe Bend. The mixture used consisted of course bar-run sand containing about 7% gravel mixed with 5% of 85/100 penetration asphalt cement. The mixing temperature was 300 to 350 F and the placing temperature 275 to 325 F. The thickness approximated 6 in., and the pavement was raked or luted to an even surface without compaction or ironing. A key ditch filled with asphalt was installed at the upper edge of the pavement. The quality used averaged 3 tons of mix per square.

APPLICATION TO LEVEE SLOPES

In addition to upper-bank paving, mass asphalt has been used for a considerable quantity of levee-slope paving. During the development period, in the early part of 1945, three sections of levee below Baton Rouge, aggregating 2,300 squares, were thus paved. The sand was produced locally from the river and was classed as fine, requiring 6 to 6½% of 85/100 penetration asphalt cement. Mixing and placing were done at the same range of temperatures used for the upper-bank paving. The mixture was produced in a batch-type central mixing plant and trucked to the levee site, where it was dumped into a steel box and placed by a crawler crane with a clamshell bucket.

Levee-slope paving is not subjected to the severe attack encountered on the river bank, and as the subbase is much more stable, it can be better prepared to receive the paving. For these reasons levee-slope paving (Fig. 1) is placed at an average thickness of 4½ in. Placing and finishing procedures are the same as for bank paving. A key ditch filled with asphalt was installed along the upper and lower edges of the pavement. About 2.2 tons of mix per square were required. Before placing the asphalt, coarse salt was spread on the subgrade at the rate of 100 lb per square. This was done to prevent or retard the growth of weeds and grass through the paving. A standard detail of the levee-slope paving is illustrated.

In addition to the levee-slope paving just described, which was performed with Government forces, a number of contracts have been let for the restoration and paving of levee slopes in the New Orleans District. During the last half of 1945, contracts for a total of 39,667 squares were awarded. The contractors have used ordinary asphalt mixing plants, trucks, cranes, and construction equipment in the prosecution of this work. Unit prices were considerably lower than for other types of pavement.

Constructive Work with Organizations Spurs Professional Growth

By George E. Barnes, M. ASCE

Professor of Hydraulic and Sanitary Engineering; Head, Department of Civil Engineering and Engineering Mechanics, Case School of Applied Science, Cleveland, Ohio

AT a time when the attention of the engineering profession is directed to the development of young engineers, Professor Barnes's address to students carries an especially pertinent message. Need for the energy and idealism of youth guided into channels of service by professional affiliation is expressed, carrying forward the convictions detailed by President Horner in his Annual Address (Civil Engineering *for August, page 333*).

First of all, the young engineer is interested in his chances for success in his chosen profession. This is praiseworthy, and stimulating to the man himself. It tends to make him exert every effort to do well whatever he is given to do, and if possible to outstrip his fellows in accomplishment. His personal success raises the level of growth and progress.

But as an engineer gains experience, he is likely to observe that a successful career in engineering is as much the result of teamwork as it is of individual exertion. As a matter of fact, it would not be putting it too strongly to say that much greater rewards go almost invariably to the man who can work with others, successfully and productively, than to the man who cannot.

The same observation applies equally well to the profession of engineering as a whole, in its relations with the public at large. For the engineering group, taken as an entity within the mass of society, must team up with other interests and work with them if the work of the profession is to be most effective. In nothing is this so clearly apparent as in public affairs, that is, in matters of government, which is created for the purpose of exerting common control over matters affecting the common good.

We assume that the engineer wishes to maintain a place of distinction and dignity in public opinion and in public affairs. To what extent then, is this already accomplished, and what are the means for further promoting these ends of particular interest to young engineers?

In the first place, we have now passed through a period of approximately fifteen years during which engineering registration has become a law in practically all states. The engineer now has legal status, and the public is protected by the fact that engineers have to meet certain minimum requirements under the law to establish their competence to practice. This is a step in the right direction. Over and above mere compliance with the law is allegiance to the principles embodied in the code of ethics of the American Society of Civil Engineers. This code has either served as the standard for, or been adopted in its entirety by, other organizations.

Then there is the work of the American Society of Civil Engineers through its manifold committees—all directed toward the development of the profession. Through these professional groups we share our experience with others. We adopt specifications for materials and workmanship and standards for the basis of design, which have been proved through joint experience to be satisfactory. This committee work often goes far beyond the codification of technical subject matter. I will mention one example, which is typical of many more. The ASCE Committee on the Organization, Financing, and Administration of Sanitary Districts is working on a manual for the guidance of administrative and public bodies (not necessarily composed of engineers) which have to do with the statutory, enabling, and management aspects of large-scale development in sanitation for communities and groups of communities. This is all based on wide engineering experience.

Frequently engineering groups are instrumental in getting legislation passed in the interest of public welfare. Examples are the interstate agreements now extant in the Ohio River basin, relating to minimum requirements for stream-pollution alleviation.

In some cities, the local engineering societies are organized for certain purposes into a so-called Technical Societies' Council. The council exerts considerable influence in public affairs. It acts as the watchdog over municipal developments. It does not meddle with the engineering work that is involved in solving municipal problems, but it presses for action on matters of importance wherein engineering knowledge is valuable. It concerns itself with such matters as transportation, water supply, airport and sanitation developments. It is frequently invited to share in the drafting of ordinances and building codes.

Individually, many civil engineers have made themselves important to their communities by civic effort. It is possible to name several civil engineers who have been heads of local chambers of commerce, local civic leagues, and kindred organizations. We could name several who have been mayors, or who have occupied even higher elective offices. Many vocations and professions have furnished managers to cities, but engineering is far in the lead.

A project of one engineering college, to interest the students in civic matters, is worth noting. A student speaker's bureau has been organized, offering speakers to civic, fraternal, and social groups, such as the Lions, the Kiwanis, the Rotary, and other clubs. Each speaker offers a popular dissertation on some engineering or scientific subject of present interest. Subjects have included such items as the Pennsylvania Turnpike, the streamlining of the Cuyahoga River, the atomic bomb, and so on.

Student speakers have done a good job and have profited much from the experience in presenting these luncheon and dinner talks. It is sometimes the first step outside the classroom toward participation in group activities in which the engineer has to meet the minds of those who are not engineers.

It is therefore vitally important that the engineer acquire at the earliest opportunity, and preferably when young, the experience of working with others toward constructive achievements. These opportunities are manifestly present in the work of professional societies, local and national, and in the activities of civic-minded groups.

Storage Reservoir Capacity on the Wisconsin River to Be Doubled

By M. W. KYLER

VICE-PRESIDENT AND GENERAL MANAGER, WISCONSIN VALLEY IMPROVEMENT COMPANY, WAUSAU, WIS.

UPON completion of the proposed Dancy Project on the Wisconsin River, practically all the economical storage capacity of the valley will have been developed. This ambitious program of a privately financed company is especially noteworthy at a time when so much attention is being given to huge, costly government hydro projects. In his address before the Midwest Power Conference, from which this account is taken, Mr. Kyler pointed out that the 23 power dams on the Wisconsin River have, even without new construction, a total operating head comparable to that of Boulder Dam.

THE Wisconsin Valley Improvement Company has just announced a plan for new construction which will increase its total storage capacity from 17 billion to $35^3/_4$ billion cu ft, or 110% of the existing capacity. The new reservoir will occupy the site of the Dancy Drainage District on the Little Eau Pleine River about 25 miles south of Wausau, Wis. (Fig. 1).

Inasmuch as the drainage area of the Eau Pleine River is sufficient only to supply about 25% of the total capacity of the new reservoir, large pumps will be used to lift flood waters from the Wisconsin River into the adjacent reservoir valley for storage. The pumps will be of the coaxial type and have a capacity of 5,000 cu ft per sec, or $2^1/_4$ million gal per min. It will take approximately 31 days to fill the 430,000 acre-ft reservoir, which will be 20 miles long and $9^1/_2$ miles wide. It will comprise a surface area of 31,600 acres. This will be the largest man-made lake in the state and will be named the George Mead Reservoir.

The reservoir will materially increase the capacity of the river for firm-power generation. When the stored water is released it will pass through 10 dams with an aggregate head of 236 ft. This flood water, which formerly was not utilized, in passing downstream will produce an additional 68 million kwhr of electricity. When present potential sites are developed—and they will be developed to take advantage of the increased river flow—the aggregate head will become 320 ft and will generate 92,000,000 kwhr. When more efficient water wheels are installed in existing plants, the total generation will be increased 110 million kwhr.

A concept of what this additional hydro power means is more easily formed when it is realized that the entire water-power production of all the plants on all the rivers of Wisconsin was only 65,588,000 kwhr in January 1945. The reported average monthly production in the entire state was about 118,000,000 kwhr in 1945, which was an exceptionally good water-power year. On the completion of the Dancy project little or no room remains in the valley for the development of additional reservoirs of any consequence.

Perhaps the most unique feature of this development of the Wisconsin River's flow is the character of the organization constructing and operating the reservoirs. The Wisconsin Valley Improvement Company is purely a public service concern. It does not own any water power, or engage in any business other than to produce, as far as possible, a uniform flow in the Wisconsin River. Stockholders in the company are the water-power users on the river (Fig 1).

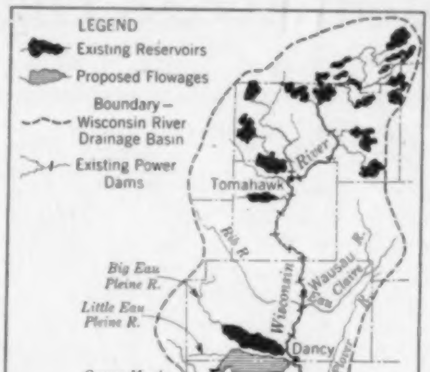


FIG. 1. SYSTEM OF STORAGE RESERVOIRS OPERATED BY THE WISCONSIN VALLEY IMPROVEMENT COMPANY

When the Improvement Company was organized in 1907, all the dams on the river were for logging, designed and used for the purpose of producing artificial floods which carried pine logs downstream to the lumber mills. This intensified the irregularities and destructiveness of the stream—the direct opposite of the need in producing hydro power. For a few years prior to the organization of the Wisconsin Valley Improvement Company, the water-power users and a few others by private arrangement and contributions managed to secure such use as was possible of the then existing reservoirs controlled as before mentioned, but no successful operation was possible, no equitable sharing of expenses could be enforced, and no material increase of storage could be accomplished.

As a result, the organization of the Wisconsin Valley Improvement Company was perfected. Nearly every water-power user on the river became pro rata a stockholder and contributed capital. Sufficient capital was readily obtained, and the existing reservoirs were brought into the control and ownership of the company. A large number of other reservoirs have since been added, and the storage capacity of the system has been increased until it has now reached 17,018,000,000 cu ft of water. Dams have been rebuilt and made permanent, and other important extensions have been effected.

All the dams of the company carry too low a head to be of any avail for water power and the manner of their use for reservoir purposes makes impossible their successful use for water power, even if they were otherwise fitted for such use.

Many other public functions are performed by the reservoir system: (1) Having used the water in the storage basins during the winter months, we find ourselves well prepared to store excess water during the spring break-up period. This reduces the high flows in the main channel, thus eliminating flood hazards. (2) Prior to the construction

of sewage disposal plants, all raw sewage was dumped into the river. This is still being done by many cities along the stream. Were it not for the reservoir system, which releases water in times of extremely low flow, much of this sewage would be deposited on the exposed stream bed or at least would increase the density of the water in parts per million. It can readily be seen that in a hot-weather, low-flow period terrible stenches would result, to say nothing of the disease possibilities. (3) Before the construction of our system the valley was subjected to floods in the spring, followed by periods of greatly diminished stream flow. This was extremely hard on aquatic life since it was subjected to alternate feasts and famines. We are therefore contributing to the welfare of fish life by providing adequate water, abounding in free oxygen. (4) Another public function rendered is the provision of spacious spawning grounds in the vast expanses of the reservoir areas.

Most lakes have natural controls, resulting in greater fluctuation in the surface. Though we are permitted a differential in the controlled lakes, much care is exercised to hold summer elevations fairly constant, the artificial reservoirs being utilized first. The most northerly reservoirs are depleted in the fall of the year. This has two distinct advantages—it reduces damaging ice-pressure ridges along the developed shore lines, and water power users on the lower river have the full use of all stored water before the spring breakup. By keeping all heads on reservoirs down below the authorized level, we are in a position to reduce flood hazards to some extent.

The 23 power dams on the Wisconsin River have an aggregate operating head comparable to that of Boulder Dam. Through the release of storage water these plants are able to maintain their own maximum operating head, thus permitting high operating efficiency, which is increased by the uniform high base flow. Without facilities for storing water, the existing power plants would require additional standby steam plants for use in periods of extremely low flow. Providing a nearly uniform flow during the entire year is one of our most important services. Some of the plants on the river today owe their very existence to the reservoir system.

Hydroelectric-power output in the entire valley has been increasing steadily, not because of increased wheel installation but because of the manner of operation through the cooperation of all participating plants. Hourly contacts between plants provide operators with advance information on what they can expect in generation.

This company has been functioning for 38 years in constructing reservoirs and operating them to control the flow of the waters of Wisconsin's principal river. By so doing it has minimized the menace of destructive floods, reduced stream pollution, and improved the propagation of fish and wild life without any cost to the public. The direct beneficiaries, the stockholders, have borne and still continue to bear the expenses of operation. Not only has the company been financed by investors, but also it has paid its way entirely as a local, state, and federal taxpaying, investor-owned organization. Its annual taxes total 31% of its gross revenues. It has never been an expense to the public treasury.

Enlarged Tax Areas Promote Construction of Limited-Access Highways

By CHARLES M. NOBLE, M. ASCE
NEW JERSEY STATE HIGHWAY ENGINEER, TRENTON, N.J.

CONSOLIDATION of several small towns into a single large tax area offers a means whereby freeways can be built without placing a prohibitive financial burden on the communities along the projected right of way. Such expedients to induce construction of vitally needed traffic arteries are essential if stagnation of commerce is to be avoided. In this article, taken from an address by Mr. Noble before a recent meeting of the ASCE Highway Division, the author lends example to his assertion that financing, not engineering, is blocking needed freeways.

POSSESSING the know-how necessary to design and construct highways to eliminate traffic congestion, engineers face a serious impasse in the unsolved problems of financing the needed freeways and parkways. The situation is especially serious in urban areas composed of a succession of small boroughs or towns. In such small communities the loss in tax ratables accompanying the construction of a limited-access highway results in a financial burden which the communities are reluctant to assume.

As a means of surmounting this obstacle, it may be desirable to unite the several small communities of an urban area in a single large tax area. The result parallels the situation presented if these communities were part of a single large city instead of separate political subdivisions. With this comparison in mind, consider the highway cost elements.

There are two principal cost elements involved in providing new traffic facilities in metropolitan areas: (1) real estate and construction costs, and (2) the loss in tax ratables to the state, county, and local governmental subdivisions.

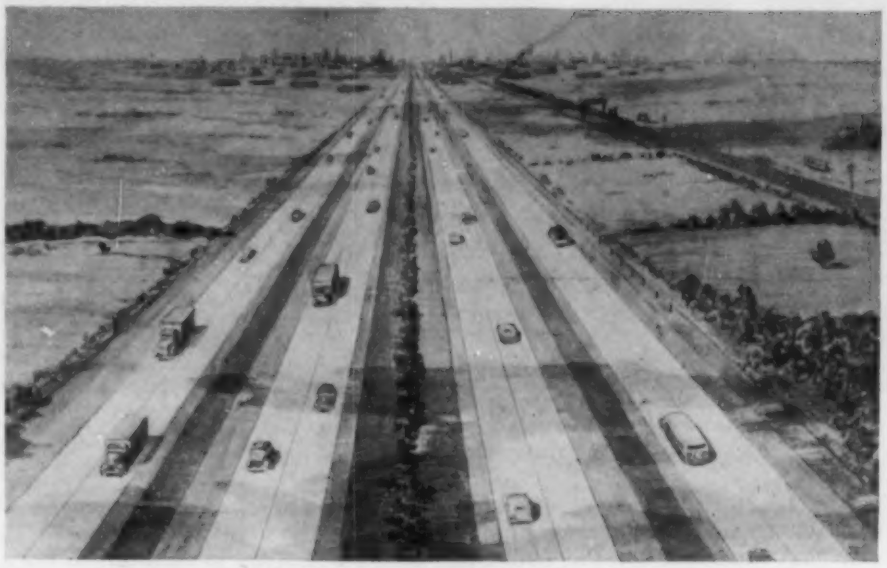
It is the latter cost—loss in ratables—which appears at this moment to present the greatest stumbling block in the path of the rapid construction of traffic-relief facilities in metropolitan New Jersey, especially in those urban areas made up of small towns. When large areas are built up solidly for many square miles, a projected highway route might cut through several communities and the construction might destroy a sizable part of the total ratables in each.

This condition may be contrasted with the case where a traffic-relief artery is constructed through a single large city. In this case it is generally possible to select a location through a continuous blighted belt. Although the same acreage of land is utilized as for a corresponding distance through a series of small communities, the proportionate loss in ratables is very much less for the larger city, and can be more readily absorbed without financial distress during the interim period required to restore tax values in the blighted areas—a restoration that will of course eventually occur because of the improvement and relief from traffic congestion. There is no such cushion in the smaller communities to take up the shock, and consequently officials and citizens in towns in the path of through

traffic-relief arteries are most apprehensive over the loss of ratables and often oppose the proposed improvement.

By combining the small communities into a single large tax area, provision can be made to adjust the burden imposed by the loss of tax ratables. If a community through which a trunk artery is projected were offered forgiveness of an equitable portion of state and county taxes for a period of years (the forgiven portion being assumed by the other communities in the above-mentioned tax area) it is believed that it would prevent a severe financial strain and would be a sufficient inducement to remove the opposition to highway improvements in built-up areas. This plan could be administered similarly to an improvement district, where assessments are made in ratio to benefits and would apply only to loss in ratables occasioned by limited-access type highways, inasmuch as a land-service improvement would compensate an affected town for loss in ratables immediately. It is believed that this is a fertile field for engineers, administrators, and legislators and that constructive work can be done which will affect favorably the development of modern highway facilities in metropolitan areas.

The traffic congestion situation is critical in urban and metropolitan areas throughout the United States and is particularly acute in New Jersey. Current traffic counts in northern New Jersey show that the volume of traffic today is 25% above 1941 in spite of lower vehicle registration caused by cars going out of service during the war years. Within the next three years, when motor-car production will soar and purchasing power will be high, congestion will reach a state of practical paralysis in many metropolitan areas unless aggressive and rapid progress is made in providing new highway facilities of superior type.



Proposed Dual-Dual Expressway for Route 100 in New Jersey

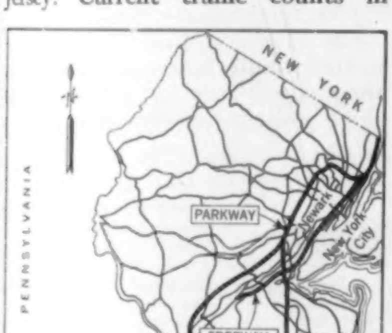


Fig. 1. Proposed Freeway and Parkway in New Jersey

In order to meet the transportation needs of the state and to assure the preservation of the transportation efficiency of expensive facilities, it is considered essential that new arteries be constructed as limited-access, grade-separated highways. Consequently an initial state-wide system of freeways and parkways has been projected at an estimated cost of $150,000,000 (Fig. 1).

As the initial step in the realization of this program, surveys and plans are now under way for the first increments of these freeways and parkways in the metropolitan area of northern New Jersey.

Of perhaps outstanding significance from a design and construction standpoint is the freeway (Route 100) which will carry a vast volume of mixed traffic and will serve the industrial and commercial requirements of the area as well as carry long-distance traffic to and from the northern New Jersey metropolitan area, the Holland Tunnel, the Lincoln Tunnel, and the George Washington Bridge. This route will traverse a heavily developed industrial area, and therefore will be projected largely across marsh and swamp areas, thus adding to construction difficulties.

Because of the heavy volume of traffic which has always characterized the metropolitan areas of New Jersey and which will continue to grow in the years ahead, the New Jersey Highway Department has long been interested in establishing unit lane capacities for highways of different classifications and has conducted studies and observations over a period of years in order to set up practical values for planning and design purposes.

Congestion Due to Inadequate Capacity Is Estimated to Cost Five Million a Year on a 21-Mile Stretch of New Jersey's Route 25

These capacity studies have indicated that it is not desirable to set up one absolute set of values, but that it is preferable to classify capacities into several groups based on time losses per mile per vehicle. These groupings and values, as evolved by W. R. Bellis of the New Jersey State Highway Department, are the basis for establishing the required capacity of the highway transportation system in New Jersey. The groupings are: (1) undesirable capacity (saturation); (2) maximum tolerable capacity:

Highways with Free Access Soon Become Constricted by Roadside Developments (Route 25, New Jersey)

(3) satisfactory capacity, and (4) desirable capacity. These groupings and lane capacities for the different classes of highways are shown in Table I.

In approaching the problem of designing Route 100, detailed studies indicated that within the foreseeable future it will be economically possible to construct only one route through this territory, since one route will exhaust the areas free from heavy industry. Consequently it was apparent that maximum traffic capacity should be built into the route. The design, a dual-dual highway, is based on the provisions of two two-lane highways (complete with shoulders) in each direction, or a total of eight lanes. The two outer roadways will serve "local" traffic and will be connected with traffic interchange facilities at reasonably frequent intervals, while the inner roadways will serve long-distance through traffic and will be provided with interchange facilities at longer intervals. The satisfactory and tolerable maximum capacities are 65,000 and 87,000 vehicles per day, respectively.

It is recognized that a design of this character will introduce difficult problems in traffic segregation and in traffic interchange facilities, and dual-dual design is not recommended for ordinary conditions, for it is believed that traffic is served more effectively by the provision of an entirely new facility in a new location when volume indicates the necessity for two, or at most three, lanes in each direction.

Traffic studies indicate that the provision of the full eight-lane capacity is not necessary initially, and construction will proceed on the basis of providing the two outer roadways, or four lanes, at the outset. The design will be such that the two inner roadways can be added as required. This will simplify the initial interchange design and avoid the necessity of reconstructing acceleration and deceleration lanes and interchange ramps when the additional roadways are constructed.

Route 100 will be merely one link in the highway transportation system of New Jersey. For example, at the present time the total north-south average daily traffic in northern metropolitan New Jersey between Newark Bay and the Orange Mountains, excluding purely local traffic, but including that moving on municipal streets, township and county roads, amounts to approximately 160,000 vehicles per day, of which 85,000 now travel on state highways. If adequate state highway routes were available now in this territory it is estimated that 140,000 vehicles per day would travel on state highways. The present satisfactory maximum capacity of existing north-south state highways amounts to only 45,000 vehicles per day; thus there is a current deficiency in state highway capacity of 95,000 vehicles per day. Upon the final completion of Route 100 (expressway), Route 4 (parkway), and scheduled improvements to Route 25, the total satisfactory maximum capacity of north-south state highways in this area will amount to 183,000 vehicles per day. It is estimated from traffic analysis that this capacity will serve until the year 1955. The tolerable maximum capacity of these completed facilities is 245,000 vehicles per day.

A similar type of traffic analysis is being made for the east-west routes in metropolitan northern New Jersey and at other metropolitan areas in the state in order to determine required present and future highway capacities. Only in this way can highway planning be put on a logical basis and integrated with overall state-wide needs.

Modern American civilization is irreparably bound up with motor transportation, but motor transportation is effective only when adequate free-flowing highway facilities are available to serve business, industry, and the individual. Adequate highway facilities are the life-blood of commerce, industry, and the American way of life. Lack of such facilities will result in the stagnation, decay, and ultimate bankruptcy of many vigorous, prosperous, and healthy communities, because flight of population and industry are the inevitable result of an inadequate highway transportation system.

The investment in buildings, industrial plants, homes, parks, schools, water supply, and all improvements which make up modern metropolitan areas, runs into billions of dollars, and it is unthinkable that this high investment should be jeopardized for lack of adequate highway transportation facilities. Therefore we should raise our sights and courageously embark on a sound, bold, long-range plan to provide for the volumes of motor traffic that can be readily predicted by modern traffic analysis. Only in this way can our cities continue young, vigorous, prosperous.

Table I. Highway Capacities for no Cross Traffic and Limited Access, Under New Jersey Conditions

Class of Highway	Lane Capacities per Hour				One-Direction Capacity per Hour		One-Direction Capacity per Day Assuming Max. Hour Is 12% of Total	
	Saturation, 5 Min Lost per Car per Mile	Tolerable Max., 1 Min Lost per Car per Mile	Satisfactory Max., 12 Sec Lost per Car per Mile	Desirable Max., No Lost Time	Satisfactory Max., 12 Sec Lost per Car per Mile	Desirable Max., No Lost Time	Satisfactory Max., 12 Sec Lost per Car per Mile	Desirable Max., No Lost Time
2-Lane (two-way)	1,200	1,000	750	500	750	500	6,250	4,440
4-Lane (undivided)	1,550	1,000	825	650	1,650	1,300	13,750	10,830
4-Lane dual	1,550	1,300	975	650	1,950	1,300	16,250	10,830
6-Lane dual	1,300	1,067	800	533	2,400	1,600	20,000	13,330
8-Lane dual-dual	1,550	1,300	975	650	3,900	2,600	32,500	21,660
12-Lane dual-dual	1,300	1,067	800	533	4,800	3,200	40,000	26,660

Engineers' Notebook

Timber Beam Loads Determined by Nomograph

By Ira J. Hooks
New York, N.Y.

By means of the accompanying nomographic chart, the extreme fiber stress due to bending and, in this respect, safe loads for timber beams, may be determined without calculation and without recourse to tables. Conversely, a suitable span and section of timber may be found for a given load when the allowable stress is specified.

Problem Illustrates Use

Use of the chart, Fig. 1, is indicated by the sloping lines drawn on its face. In the illustration shown, it is required to find the extreme fiber stress due to bending in a timber beam 6 in. by 12 in. by 9 ft long, with a uniformly distributed load of 16,000 lb. With a straightedge connect $b = 6$ in. to $d = 12$ in.; and $W = 16{,}000$ lb to $L = 9$ ft. At the intersections connect pivot lines I and M; whence the extreme fiber stress, read on S_m, is seen to equal 1,500 lb per sq in. The loading is safe for a timber of this value.

For concentrated loads at the center of a span, double the load for the value of W before entering the chart. Similarly, other adjustments in value for W may be made for cantilever beams or for other load conditions. Note that "total load" includes the weight of the beam itself. It is necessary to check short, heavily loaded spans for shear.

Figures in b and d indicate nominal timber sizes, that is, these are actual timber sizes. For commercial dressed lumber, take $^1/_2$ in. less except for 4-in. sizes and less, for which take the values shown by an arrow below the nominal size.

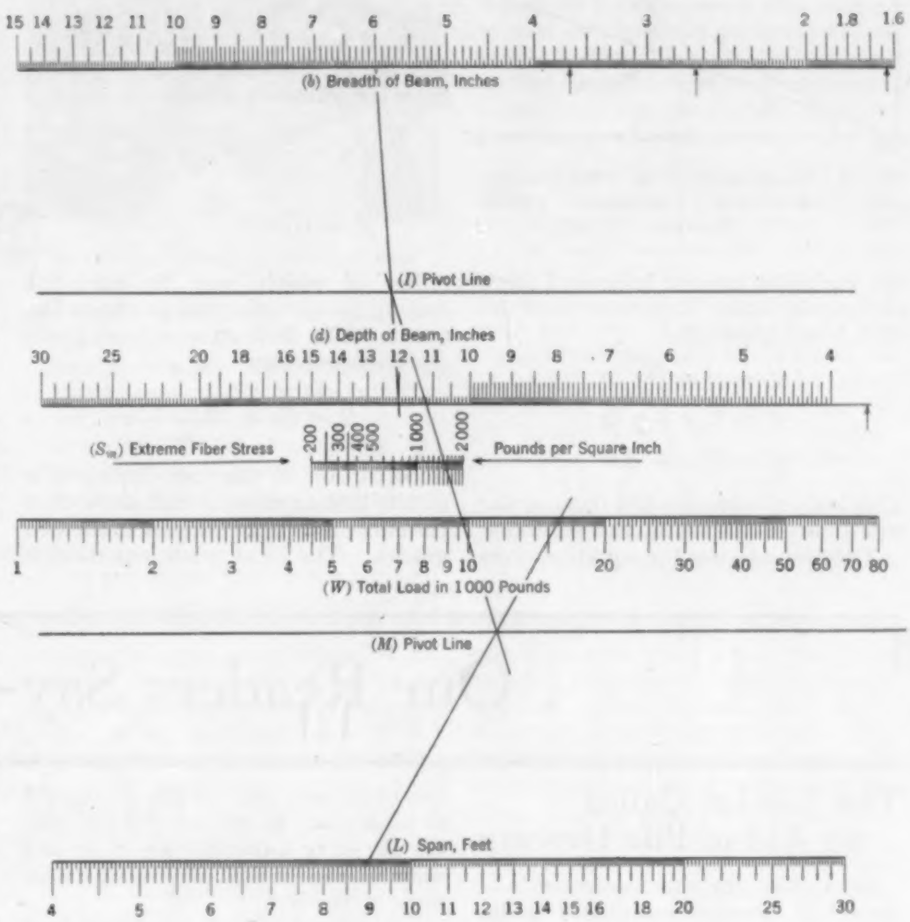


Fig. 1. Nomograph for Timber Beam Loads

Surveyor's Parabolic Vertical Curve Simplified

By John A. Oakey, Assoc. M. ASCE
Chairman, Department of Civil Engineering, North Dakota State College, Fargo, N.Dak.

Route surveying has suffered from a chronic lack of understanding of the principles of parabolic vertical curves. Various expedients frequently are used because of incomplete knowledge of an extremely simple matter. Primary characteristics of the commonly used parabolic vertical curves can readily and clearly be explained.

The sketch, Fig. 1, shows two grades, G_1 and G_2, meeting a V.I. of known elevation. A grade is the tangent of the angle of inclination, i.e., the difference in elevation divided by horizontal distance. The problem then consists of connecting these two grades with a smooth curve, having a horizontal length of L, which will be exactly tangent to the two grades, and of finding the proper elevations of stations on the curve.

As indicated in the sketch, it is most convenient to assume the origin for the curve to be at the V.C. and to compute all the vertical offsets to the curve from the back grade or back grade extended by an equation of the form,

$$y = Kx^2$$

in which y is the vertical offset and x is the horizontal distance from the

V.C. The two variables are measured in two mutually perpendicular directions but the equation is not in rectangular coordinate form, since

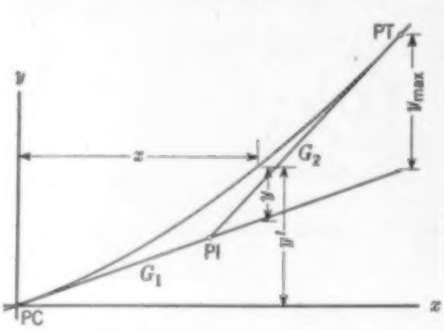


FIG. 1. INTERSECTION OF TWO GRADES AND CONNECTING PARABOLIC CURVE PLOTTED

the variables are not measured from rectangular axes. Examination of the sketch will show that

$$y' - y = G_1x \text{ or}$$

$$y' = G_1x + y \text{ or}$$

$$y' = G_1x + Kx^2$$

This last expression is the rectangular coordinate equation of the parabola.

The derivative of the equation gives the slope or local grade, G, at any point on the curve, or

$$\frac{dy'}{dx} = G = G_1 + 2Kx$$

From the requirement that the curve be tangent to the grades, it follows that $G = G_2$ when $x = L$. Substitution of these values gives

$$G_2 = G_1 + 2KL, \text{ or } K = \frac{G_2 - G_1}{2L}$$

The use of this value of the constant gives the following equations,

$$y = \frac{G_2 - G_1}{2L} x^2 \text{ and}$$

$$y' = G_1 x + \frac{G_2 - G_1}{2L} x^2$$

either of which may be used for finding the elevations of points on the curve. The derivative or local grade equation becomes

$$G = G_1 + \frac{G_2 - G_1}{L} x$$

Substitution of the two limits of x in the last expression will show that the curve is exactly tangent to the two grades. The local grade equation is useful in finding the distance from the V.C. to high or low points on a vertical curve. Obviously, at these points the local grade, G, is zero. Using this known fact, the distance from the V.C. to sags or summits is given by

$$x = \frac{G_1}{G_1 - G_2} L$$

Before any of these equations can be used, it is necessary to find the distance from the V.I., the point of known position, to the V.C., the origin for all equations. This will be done by assuming that the distance from the V.I. to the V.T. is z. At the V.T., y is maximum and its value can be found by

$$y_{max} = \frac{G_2 - G_1}{2} L$$

It is obvious from the figure that

$$y_{max} = zG_2 - zG_1 = (G_2 - G_1)z$$

Comparison of these two equations shows that

$$z = L/2$$

In other words, the V.C. and the V.T. both lie a horizontal distance of $L/2$ on each side of the V.I.

Our Readers Say—

The Air Jet Called an Aid in Pile Driving

DEAR SIR: In the September issue Ernest E. Howard contributes to the literature of pile driving in his article on the use of the air jet in pile driving. It is a well-known fact that the downward flow of water through quicksand compacts the grains to a high bearing value, while an upward current makes a liquid of the mass with no bearing value. Furthermore, deep well pumping by discharging compressed air a proper distance below the surface of the water causes upward flow through the well pipe, as the weight of the combined mass of expanding air bubbles and water is less than the hydrostatic pressure at the depth of discharge.

Effectiveness of an air jet used in pile driving will obviously depend upon the character of the material through which the pile is being driven and upon local conditions determining the direction and area of flow of either air or water used in jetting. Compressed air used with a water jet should facilitate the upward flow of water. If the material through which the pile is driven is subject to action of the jets, then the pile driving will be facilitated. In the case of a pipe pile, the air jet or a combination of air and water jet may be used to excavate the interior of the pile.

The manual on pile foundations and pile structures states that "Obviously, such a manual cannot be written for all time; it can contain only a brief statement of presently accepted principles and practices, subject to additions and changes as time and experience yield clearer insight into the problems." While the manual does not attempt to describe pile driving apparatus in detail, there should be a reference to the information contributed by Mr. Howard when the next edition of the manual is issued.

The footnote to Table 2, on page 28 of the Manual, should have stated that the article in the September 1941 PROCEEDINGS, mentioned at the head of the table and from which the information in the table was taken, was by G. G. Greulich, M. ASCE.

R. E. BAKENHUS, M. ASCE
Chairman, Committee on Bearing Value of Pile Foundations

New York, N.Y.

Error Misleads Discusser of Spillway Model Data

TO THE EDITOR: The discussion, in the August issue, by Mr. Hall of the writer's paper, "Model and Prototype Studies on Unique Spillways" (Fontana Dam), which appeared in the June issue, contains some interesting but in this case erroneous conclusions. Considering the data as presented in Figs. 1 and 2, it would appear that Mr. Hall is entirely correct in his conclusions. Unfortunately, however, between the time the original manuscript left the writer's hands and the time it appeared in the June issue the captions on Figs. 1 and 2 were reversed. Thus, the data presented as model data were actually for the prototype, and vice versa.

The writer did not believe it necessary to call attention to this error after the article appeared since the text and all references in the text to length of jets and erosion depths consistently pointed to the fact that the captions were interchanged. Also, the photographs showing model and prototype comparisons indicated a longer model trajectory.

The discussion by Mr. Hall of the diffi-

culty in building model surfaces smooth enough to obtain the proper coefficient of roughness between model and prototype is thoroughly recognized by the writer and others connected with these tests. The velocities used in the model tests were not the result of building a geometrically similar model and using the resulting velocities at the tunnel outlets. Considerable time and thought were given to the method of obtaining the proper outlet velocities. Briefly, studies were made at near-prototype velocities to determine the probable losses and the resulting outlet velocities in the prototype structure. The model was then adjusted until the velocities agreed with the predicted prototype velocities. This was of prime importance since the correct solution of the problems at the tunnel outlets and in the channel depended entirely on obtaining proper outlet velocities.

Actually, the model and prototype outlet velocities did agree for the 10,000-cu ft per sec discharge. As stated in the article, the water at the tunnel outlet was "about 5 ft" deep. Some difficulty was experienced in making this measurement, but it is believed to be correct within a few inches. Assuming this depth to be exactly 5 ft, the velocity was found to be the same as shown on the velocity curve used for the model test, 120 ft per sec. Therefore, any difference between model and prototype trajectory length is due to greater insufflation and a more thorough breaking up of the prototype jet after leaving the bucket.

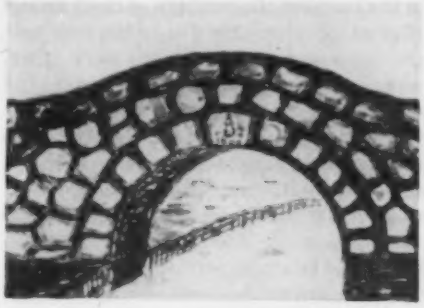
The writer believes the additional information given here will be of interest to Mr. Hall and should be considered before any final conclusions are made.

A. J. PETERKA, Assoc. M. ASCE
Hydraulic Laboratory, U.S. Bureau of Reclamation
Denver, Colo.

Bridge Structure in Guam Defies Bombs

DEAR SIR: As geologist in charge of field work in development of the water supply of Guam following the invasion and reoccupation of that country, I watched the progress of construction of a modern rigid-frame bridge being built by the Seabees at Agana. The Agana River originally passed through the town, but was later diverted around it to make way for the rebuilding of a new and modern city. The new bridge, of course, crossed the new river channel.

Through military necessity the city was destroyed by naval gunfire and bombing during the reoccupation of Guam in 1944. The new cathedral, the governor's palace, and practically every other building were demolished beyond repair, if not completely obliterated. There were a few exceptions, however, and one of these was an old stone bridge across the Agana River, a small sluggish stream that meanders through the town. Although surrounded on all sides by bomb craters, the structure was spared a direct hit and, aside from having a few



OLD STONE BRIDGE AT AGANA, GUAM

chunks of rock broken off, was intact and is still in use.

Since photography was not permitted, I made a sketch of the bridge, which is shown here. While making the sketch, I discovered that the keystone bore the weathered image of a woman and, below it, the date, "1800." Later I learned that the image represented Isabella, Queen of Spain.

Even more remarkable is the fact that this old bridge has survived the many and often severe earthquakes that are so common to the region. On September 22, 1902, an intense quake destroyed or damaged nearly every masonry structure on the island, including most of the bridges. South and east of Guam the ocean floor drops away to a depth of 31,000 ft, one of the deepest depressions in the world, and the earth's crust in this region is very unstable.

It is to be hoped that the bridge will be preserved as a historic monument, together with another and even more ancient relic, the monument commemorating the visit of Magellan in 1521. The latter is in a small village on a bay at the southern end of the island, and was untouched by the war.

Seattle, Wash. RAYMOND CUTTER

Model and Prototype Studies Are Compared

TO THE EDITOR: I have read Mr. Hall's letter, in the August issue, commenting on the Fontana model and prototype comparison with some concern. Both the model tests in the TVA's hydraulic laboratory and the prototype observations were conducted under my direct supervision, and I should like to correct a number of misapprehensions that appear in Mr. Hall's letter.

It is unfortunate that the captions for Figs. 1 and 2 in Mr. Peterka's original article (June issue), which Mr. Hall is discussing, were reversed. As captioned, the figures do not bear out Mr. Peterka's statement, "It will be noted that here too the model shows a longer trajectory than the prototype." It is certainly true, however, that the trajectory of the model jet was longer than the corresponding prototype jet. This is clearly shown in the photographs. No reasons for the discrepancy were assigned because they were not positively shown. Several factors undoubtedly contributed, but the quantitative effect of each is not known nor is it certain that all the factors have been recognized.

One cause of the discrepancy lies in the difference between the model and prototype discharges. The jet pattern shown for the model was obtained with a discharge of 12,500 cu ft per sec and that for the prototype with a discharge of 10,000 cu ft per sec. The velocity and the length of the trajectory increase with the discharge. Model tests were not made at 10,000 cu ft per sec. However, a curve of the trajectory length versus discharge, made from the tests results available, indicates that the trajectory length measured from the end of tunnel No. 2 should be about 480 ft for the model. This is 105 ft greater than the corresponding prototype jet.

Mr. Hall's assumption that the model velocities were lower than the corresponding prototype velocities because of relatively greater friction losses in the model is entirely unwarranted. The fact that the prototype roughness could not be reproduced in the model was recognized. Careful studies of friction losses in the component parts of the spillway tunnel system were made, and from these the prototype outlet velocities were estimated.

For a discharge of 10,000 cu ft per sec, they were 126 and 118 ft per sec at the ends of tunnels No. 1 and No. 2, respectively. The corresponding velocities were produced in the model at the proper depth of flow by placing orifices in the tunnel a short distance upstream from the outlet. (The orifices were of the proper size and shape to produce at the outlet a stream having a velocity corresponding to that calculated for the prototype. In operation of the model, the discharge was supplied and the tunnel above the orifice filled with water until steady flow condition existed.) As an added precaution, outlet velocities were checked by pitot tube. The model did not simulate the prototype throughout, but at the tunnel outlet there was good agreement with the calculated prototype velocities.

It is believed that aeration had very little effect on the flow conditions observed. The water at the tunnel outlet was solid for a depth of 5 ft with a flying

cloud of spray above it, through which the water surface could be seen at intervals. The total quantity of water in this loose spray is very small and probably has no significant effect on over-all friction losses. The velocity of a discharge of 10,000 cu ft per sec at a depth of 5 ft in a tunnel 34 ft in diameter is 120 ft per sec. This is reasonably good agreement with the velocity of 126 ft per sec calculated for the model tests. (Mr. Hall's assumption of a tunnel flowing half full at a velocity of 120 ft per sec would result in a discharge of 54,500 cu ft per sec, a much greater discharge than has been experienced. The effect of aeration at this discharge is expected to be negligible.) It is believed that Mr. Hall's conclusions regarding the effect of aeration (under conditions where the depth of flow is relatively great with respect to the length, as in the Fontana spillway tunnel) are considerably in error.

No solid water was seen in the prototype jets after they left the buckets. The visible portions were composed entirely of white spray, which high-speed motion pictures show to be retarded considerably by air resistance. The dimensions of the jet near the top of the trajectory may be estimated conservatively from the photographs as 75 ft in width by 20 ft in thickness. Assuming that the velocity at that point was only 80 ft per sec, the density of flow through the cross section would have been only one-twelfth that of solid water. It is evident that considerable opportunity is offered for retardation by air resistance, and that such resistance was an important factor contributing to the shortening of the prototype jet. This is confirmed in part by the shape of the trajectory, which was much steeper after the highest point had been reached than before, indicating a reduced velocity during flight.

It is to be regretted that Mr. Hall was misled by the transposition of the captions into drawing conclusions so far at variance with the facts.

G. H. HICKOX, M. ASCE
Norris, Tenn.

Aerodynamic Studies Aid in Bridge Design

TO THE EDITOR: In the interesting article by F. B. Farquharson, M. ASCE, entitled "Lessons in Bridge Design Taught by Aerodynamic Studies," in the August issue, the thought is expressed that truss-type sections differ radically from girder-type sections in aerodynamic response.

There is no magic aerodynamic virtue inherent in the use of trusses instead of girders in the bridge cross section. In general, for any truss-type section there is an equivalent (shallower) girder-type section that will show the same aerodynamic characteristics. The advantages of using trusses are in their usually greater depth, stiffness, and structural damping, not in any mysterious aerodynamic superiority.

The aerodynamic differences recorded in the tests for the redesign of the Tacoma Narrows Bridge were due to the fact that the truss and girder sections were otherwise not comparable. The truss-type section was of the top-deck form. Girder-type sections with top deck yield the same aerodynamic characteristics. This is shown by static wind-tunnel tests of section models, made for the writer. When the section is deck, instead of half-through, the static torque graph is modified and shifted horizontally on the axis so that the point of zero ordinate (or maximum slope) is no longer at the zero angle of incidence but at a higher (upward) critical angle of incidence. The use of a top-deck section (whether truss or girder) does not eliminate aerodynamic instability but merely shifts it to another angle of incidence. In a bottom-deck section, the shift would be reversed, and a corresponding downward angle of incidence would be critical. This would be the safer arrangement for the upward inclined winds at Tacoma.

Contrary to publicized statements, the Tacoma Bridge failure was not caused by the use of solid-web girders instead of open trusses. The bridge (of torsionally unstable section) failed because of its extreme flexibility and low structural damping. An aerodynamically equivalent truss section of equal flexibility and low damping would have been equally vulnerable.

Despite the substitution of deep open trusses for shallow girders in the redesign of the Tacoma Bridge, the proposed section had catastrophic torsional instability, and the problem was not solved until roadway slots were added. The provision of suitably located openings in the roadway has been persistently advocated by the writer in the face of skepticism for the past six years. These roadway vents, and not the substitution of trusses for girders, should be credited for yielding an aerodynamically stable section for the new Tacoma span.

Girder-type sections of assured vertical and torsional stability are available. Further analysis and tests will reveal additional stable forms of girder-type sections and equivalent truss-type sections. The use of solid-web girders offers definite aesthetic and economic advantages. It would be unfortunate to scrap these advantages and to limit bridge designers in the future by perpetuating a misleading and unfounded conclusion.

D. B. STEINMAN, M. ASCE
Consulting Engineer
New York, N.Y.

Analysis of Factor of Safety Questioned

TO THE EDITOR: Professor Burmister's discussion on the factor of safety, in the July issue, is timely since, even in its simplest form, this factor is subject to misinterpretation. Whether the factor is applied to stability of an earth slope or of another structure, it should lead to sensible answers—that is, it should be greater than unity, if the structure is to be considered safe.

When a structure is on the verge of overturning or rotating, the factor of safety should be equal to unity. Any excess of restraining forces should be expressed as a surplus over unity.

Analyzing Professor Burmister's Eq. 1, one finds that when $C = 0$ and $W_1l_1 \neq W_2l_2$, then $F.S. = 0$. Then, when $C = 0$ and $W_1l_1 = W_2l_2$, $F.S. = \frac{0}{0}$, or indefinite. When $C \neq 0$ and $W_1l_1 = W_2l_2$, $F.S. = \infty$. Thus the limits of safety factor are between 0 and ∞. This mere fact makes it very difficult to agree with the definition of the safety factor as given in Eq. 1, because if a safety factor equal to 10,000 were obtained, it would be hard to comprehend its meaning on account of the wide range of variation of its values.

On the other hand, by applying the same criteria to the factor of safety as expressed in Eq. 3, we find that, with $C = 0$, $F.S. = \frac{W_2l_2}{W_1l_1}$, or that if $W_2l_2 > Wl_1$, then $F.S. > l$, in regard to the anticipated motion from right to left; if $W_2l_2 = W_1l_1$, then $F.S. = l$, or on the verge of rotating, and if $W_2l_2 < W_1l_1$, then $F.S. < l$, in regard to motion from right to left. Safety factors for motion from left to right should be considered separately.

When $C \neq 0$ and $W_2l_2 = W_1l_1$, then $F.S. > 1$. Thus, Eq. 3 gives measurable factors of safety varying from 0 to unity and over.

A few years ago the writer had a chance to investigate in detail the factors of safety in overturning for gravity dams. There, for a dam subject to three forces—vertical, own weight, V, acting downward; horizontal, water load, W; and vertical upward acting uplift, U—a situation arose similar to the one just cited.

The expression usually employed for the factor of safety in overturning is $K_o = \frac{M_v - M_u}{M_w}$, where moments M are taken about the downstream face at base. This expression is impractical for the same reason that Eq. 1 is. The better expression would be $K_o = \frac{M_v}{M_w + M_u}$, which is of the same type as Eq. 3 and gives the same range of numerical values.

I. M. NELIDOV, M. ASCE
El Cerrito, Calif.

California Pioneers Snow Forecasting

To the Editor: In connection with Mr. Work's article, "Snow Surveys Forecast Irrigation Water Supply," in the August issue, the experience of the State of California along this line may be of interest. In the checkerboard of snow surveys that Mr. Work describes as existing in 1935, California was one of the outstanding squares—a square in which even at that early date an army of skiing surveyors were systematically weighing a 17,000-sq mile snowpack in their hollow metal tubes.

Organized in 1929 by the State Engineer, the California Cooperative Snow Surveys have been coordinated and developed under his guidance until today the snow survey network in this state includes 254 snow courses—more than one-quarter of the total in the 11 Western states.

Forecasts of runoff by the State Engineer are geared to the requirements of the water-using organizations, and cover watersheds of many different sizes, from the abbreviated 65 sq miles above Bowman Dam on the Yuba, to the sprawling 6,650 sq miles feeding Shasta Dam. Forecasts are made on April 1, based on snow then on the ground, and assuming a normal April to follow. If April is not normal, the forecasts are modified on May 1, to allow for the influence of the April weather vagaries.

Table I. Analysis of Forecasting Results at Lowest Station on Major Rivers of California

River and Station	Good	Fair	Poor	Total
Sacramento at Shasta Dam	5	1	0	6
Feather at Oroville	2	4	0	6
Yuba at Smartville	2	6	1	9
American at Fairoaks	3	5	3	11
Mokelumne at Moke. Hill	6	5	0	11
Stanislaus at Melones	3	7	1	11
Tuolumne at La Grange	7	4	0	11
Merced at Exchequer	8	2	1	11
San Joaquin at Friant	9	2	0	11
Kings at Piedra	9	2	0	11
Kaweah at Three Rivers	3	5	3	11
Kern at Bakersfield	6	2	3	11

The degree of success attending these forecasts from 1933 to date is shown in Table I. The grading is to the standards of the Western Snow Conference, "Good" being within 10% of exact accuracy, "Fair" indicating a difference of from 10% to 20%, and "Poor" a divergence of more than 20%. The overall score shown by the table is: "Good" 52%, "Fair" 38%, "Poor" 10%.

While this degree of forecasting accuracy is fairly satisfactory, constant improvement is sought. In the field, strategic coverage is expanded as opportunity occurs, and the search never ceases for more representative snow-course locations to substitute for those less dependable. In the office, forecasting procedures are systematically revised and kept up to date.

This year many water-using organizations are united in a project to provide storage precipitation gages for many of the blind spots of the Sierra, where the total precipitation has never been measured. Funds for 40 of these gages are available and plans are to complete installation before the coming wimter. These storage gages on 15-ft towers will have capacity to contain the total precipitation for an entire season, whether as snow or rain. It is hoped that the precipitation data so gathered will supplement the snow-survey information and provide an additional tool for runoff forecasting.

It seems reasonable to expect that, as time goes on and as more study is put into the matter, forecasting will improve. The goal is to have all forecasts within 10%. That future is close when the surplus waters of the state will no longer waste out to the ocean through the Golden Gate, but will be completely conserved for the 20 million people who will have their homes in California. Management then will need forecasts of runoff as accurate as the engineer can possibly make them.

Fred Paget, Assoc. M. ASCE
Senior Hydraulic Engineer,
State Div. of Water Resources
Sacramento, Calif.

Definition of Safety Factor Questioned

Dear Sir: The soundness of the proposal made by Professor Burmister in his letter to the editor, entitled "Factor of Safety in Stability Analyses," in the July issue, seems to me to be open to question. To the writer, the essence of a factor of safety is the ratio of the average strength of a material to the average stress. If such an empirical method as the Swedish Circle is accepted then, on the basis of Professor Burmister's comments, his Eq. 1 may be considered to be correct.

Consider the accompanying Fig. 1, where $W_2 = W_3$, $l_2 = l_3$, and $l_2W_2 = l_3W_3$. The movement $l_1W_1 = l_3W_3 + l_4W_4$, where l_1 and W_1 are defined in Professor Burmister's Fig. 1. The factor of safety can be written as follows:

$$FS = \frac{clr}{l_4W_4} = \frac{clr}{l_1W_4 + l_3W_3 - l_2W_2} = \frac{clr}{l_1W_1 - l_2W_2} \quad . \; . \; . \; . \; . \; . \; (1)$$

which is the same as Professor Burmister's Eq. 1. The counterbalancing of l_2W_2 and l_3W_3 appears reasonable for a retaining wall having water on both sides not at the same elevation. Then if the hori-

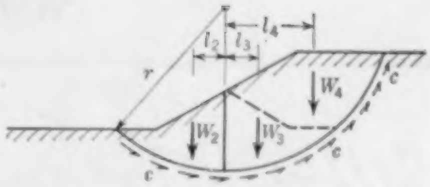


Fig. 1

zontal water pressure, P_1, on the right side is greater than that, P_2, on the left side, and if the frictional effect of wall weight is neglected, then the factor of safety of the wall against horizontal shearing is:

$$FS = \frac{S}{P_1 - P_2} \quad . \; . \; . \; . \; . \; (2)$$

and not

$$FS = \frac{S + P_2}{P_1} \quad . \; . \; . \; . \; . \; (3)$$

which would follow from Professor Burmister's criterion, where S is the shearing strength of the wall. Eq. 2 is based upon the ratio of strength to stress of the material of interest, while Eq. 3 is not.

R. A. Barron, Jun. ASCE
Assoc. Engineer (Soil Mech.)
U.S. Engineer Office
Providence, R.I.

President's Address Gets Words of Praise

To the Editor: I have just read Mr. Horner's presidential address, "Stewardship of Professionalism Given High Priority," as published in the August issue of Civil Engineering, and I cannot help writing to say how immensely interesting I found his summary of the professional growth of the civil engineering profession. When I first entered the employ of the Society, the standing of the member was high, but the point of view was individualistic.

As so much of my working life was given to the American Society of Civil Engineers, and as it has always been to me the best and greatest of the engineering societies, it is supremely gratifying to read Mr. Horner's stimulating account of the broadening of its activities in recent years, and of the leadership it has assumed in this wider field, and that the many resulting problems are well on the way to solution.

The stirring appeal to the younger men to carry on will surely be heeded. I rejoice in the leadership that the Board of Direction is giving to the engineering profession.

Eleanor H. Frick
Librarian, ASCE, 1897–1916
Office Manager, 1916–1921
Office Manager and Asst. to the Sec'y, 1921–1936
New York, N.Y.

SOCIETY AFFAIRS

EDITORIAL:

Why "Technical Tedium"?

ASCE Director Roy W. Crum really started something with his article, "Technical Tedium or Otherwise" (CIVIL ENGINEERING, July 1946, page 318), in which he satirized Technical Division meetings. Three contributors to the "Our Readers Say" department for September were moved to comment on this article and the oral presentations made by authors of papers at recent Society sessions.

"Unpleasant memories of the technical sessions," "some of the papers were poorly prepared and more were poorly presented," "muttering through his whiskers, with his back to the audience"—these and similar comments characterized the letters of these members, who not only recognize, but are growing less content to accept, "the fact that engineers are notoriously poor speakers." In two of the letters to the editor, it was emphasized that "we must train our members to speak."

There is no doubt that some such program is long overdue, or that one must be initiated soon if technical sessions are to make to the profession the valuable contributions of which they are capable.

However, such programs are not achieved, or even initiated, by any push-button method. It isn't merely a matter of deciding something should be done to make the engineer a more forceful speaker. Individuals must take hold of this idea and, imbued with the will to utilize available self-improvement facilities, must undertake the detailed tasks which always are so vital a part of any group activity.

A few of our Local Sections have taken steps toward vocal presentation improvements. These Sections have availed themselves of the assistance offered by an organization known as Toastmasters International of Santa Ana, Calif. This organization is non-profit and non-commercial in character, and it declares its fundamental purposes to be: "To aid its members to master the difficult art of public speaking; to teach them to appear effectively before any audience; to train them to preside efficiently at meetings of all kinds."

Under a prescribed program, meetings of these Toastmasters' units are held weekly, with all members starting from scratch and mutually assisting one another in this self-improvement work. Doctors, lawyers, teachers, bankers, salesmen, business executives and others are doing it in some 400 widely distributed clubs.

Surely an early cure for "technical tedium" is most earnestly to be desired. So why not some of the same medicine for engineers?

Revision Made in Report on Recommended Salaries

FOLLOWING the July meeting of the Board of Direction, readers of CIVIL ENGINEERING were informed of a forthcoming interim report on a new classification and salary schedule. The Board of Direction considered a preliminary interim report by the Committee on Salaries at the Summer Convention in Spokane in July. The Board approved the report, but later it was found that it was not clear in some important details.

The Committee on Salaries met in St. Louis, Mo., September 9 and 10, for further study of the matter, and an expanded and clarified interim report was developed there. It will be submitted to the Board at the October meeting in Kansas City.

The new report supersedes and has been substituted for the July report. It is expected that Board action at Kansas City in mid-October will permit CIVIL ENGINEERING to carry in full in its November issue the interim report and recommendations of the Committee on Salaries.

Committee Proposes Policy on Labor Law

DRAFTING of a proposed statement of labor legislation policy for ASCE, and of a similar statement to be recommended by the Society to Engineers Joint Council, was completed at a special meeting of the ASCE Employment Conditions Committee in St. Louis, Mo., September 7 and 8. Committee members attending were Vice-President Gail A. Hathaway, Washington, D.C., chairman; Clarence D. Bowser, Columbus, Ohio; Sterling S. Green, Los Angeles, Calif.; C. W. Okey, Knoxville, Tenn., and Ernest W. Whitlock, New York, N.Y. Director F. W. Panhorst, Sacramento, Calif., vice-chairman of the committee, was unable to attend. Sitting in with the committee were President W. W. Horner, Executive Secretary William N. Carey, and E. L. Chandler, the Society's Washington representative.

Both statements will be considered by the Board of Direction when it meets October 14 and 15 in Kansas City, Mo., at the time of the Society's Fall Meeting in that city. The Society's Employment Conditions Committee held the special meeting to consider a labor policy proposed for all constituent societies of Engineers Joint Council by the EJC subcommittees on Economic Status of

the Engineer and on Collective Bargaining (CIVIL ENGINEERING, July 1946).

The ASCE Employment Conditions Committee made some changes in the statement of policy outlined by the EJC subcommittees, and will recommend to the Board of Direction that it forward the altered proposed statement to EJC with recommendations that the changes be incorporated in the overall EJC policy statement. The changes recommended are, of course, consistent with the policy drafted by the Employment Conditions Committee for ASCE itself. All constituent societies were requested by EJC to make suggestions on which the joint engineering organization then could act.

Students Urged to Use Illustrated Lectures

FOR MANY years the Society has maintained at Headquarters a group of illustrated lectures primarily for presentation before Student Chapters. No expense whatever is incurred in borrowing these lectures, as the Society pays the shipping charges both ways.

This year the list of illustrated lectures includes the following 28 subjects:

Lectures	Date Made
Aerial Photographic Mapping	1941
Bonneville Dam	1939
Boulder Dam	1938
Carquinez Strait Bridge	1930
Cascade Tunnel	1929
Catskill Water Supply	1939
Conowingo Hydroelectric Development	1929
Construction of Chicago Subway System*	1942
Coolidge Dam	1930
Florianopolis Bridge	1930
Foundation Problems of West Side Elevated Highway—New York	1939
George Washington Bridge	1935
Golden Gate Bridge	1938
Grand Coulee Dam	1940
Hetch Hetchy Water Supply	1929
Holland Tunnel	1930
Miami Flood Control	1929
Mississippi River Flood Control	1940
Norris Dam	1939
Power Development at Niagara Falls	1929
Queens Midtown Tunnel	1942
San Francisco–Oakland Bay Bridge	1939
Tacoma Narrows Bridge Failure*	1942
Traffic Jam Ahead†	1944
Waterloo Bridge (prepared by the Institution of Civil Engineers, London)	1943
Westchester County Park System	1935
Wheeler Dam	1939
Wilson Dam at Muscle Shoals	1929

* Includes film. † Record and film—no lecture.

Each of the lectures consists of a mimeographed talk keyed to fifty or sixty slides (except where otherwise noted). The simplest method of presentation is obviously to read the lecture while the slides are being shown. However, it is suggested that, instead, the lecturer study the material in advance so that he can use the written lecture merely as an outline for his talk, and be able to answer questions from the floor.

A request to Society Headquarters, reserving a particular lecture, should be sent well in advance of the date of presentation.

ARTIST'S SKETCH OF $100,000 NEW HEADQUARTERS FOR MILWAUKEE ENGINEERS

New Building Houses Milwaukee Engineers

THROUGH its affiliation with the Engineers' Society of Milwaukee, the Wisconsin Section of ASCE has acquired the use of a handsome headquarters building in Milwaukee, Wis. This palatial home, built by Frederick Pabst of Pabst Brewery fame, was purchased by the Engineers' Society of Milwaukee in 1944 and has since been remodeled to embody the latest improvements, such as indirect lighting and acoustical ceilings, while at the same time retaining its architectural style.

It provides complete and modern facilities. For discussion groups and technical meetings there are three small auditoriums, each with a seating capacity of about a hundred, and so arranged that two may be opened to the same program by means of sliding wall panels. Other features include a library and reading room, recreation room, offices, committee meeting rooms, lounges, kitchen, checkroom, and large dining room seating 125, to which is connected a smaller dining room seating 75. The ladies were not forgotten, having been provided with a recreation room.

The cost of remodeling and equipping the building was met by a fund of $100,000, raised by conducting a campaign among the various industries in the area. More than a hundred firms contributed.

Founded in 1904, the Engineers' Society of Milwaukee now has a membership of over 1,300 engineers. Among the affiliated groups, in addition to ASCE, are the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Refrigerating Engineers, American Society of Heating and Ventilating Engineers, Institute of Radio Engineers, and the Illuminating Engineers Society.

To celebrate the opening of the building, a banquet was held in the municipal auditorium, at which the chief speaker was Charles F. Kettering, Hon. M. ASCE. About 1,600 engineers and friends attended the dinner and heard his address on "The Challenge and Opportunities of Tomorrow." The ASCE official representative on this occasion was Director R. W. Gamble of Milwaukee. Because of its affiliation with the Engineers' Society of Milwaukee, the Wisconsin Section of ASCE will be able to make use of the headquarters building as individuals and as a group for Section meetings, as desired.

Bargaining Group to Be Formed at Sacramento

PLANS continued to take shape for formation of a national federation of professional employees' collective bargaining groups, with an organization meeting scheduled at Sacramento late in September.

Donald B. Slawson, Portland, secretary of the Engineers Guild of Oregon, who was elected secretary of the exploratory committee organized in Spokane, when representatives of 10 Western bargaining units took advantage of their joint presence at the ASCE Summer Convention to make preliminary plans, has heard from most of the groups represented at Spokane, and has tentatively set September 28 as the date for the organization meeting.

Each group was scheduled to send two representatives to the organization meeting in Sacramento, where it was hoped to form a permanent organization. Mr. Slawson emphasized that while those who met in Spokane and planned the federation, the name of which has been suggested as "National Professional Employees Association," were from the western part of the country, it is hoped to include similar units from all over the nation.

Ethics Prizes Offered to Young Engineers

THROUGH the generosity of Daniel W. Mead, Past-President ASCE, a prize of $50 in cash is offered to the Junior who writes the best paper on the subject of: "The Desirability of a Code or Canons of Ethics for Engineers." Members of Student Chapters are offered a separate prize of $25 for the best essay on the same subject.

The rules governing the Daniel W. Mead Prizes, as printed on page 87 of the 1945 ASCE Yearbook, are as follows:

I. The Daniel W. Mead Prizes for papers on ethics shall consist of a Junior prize of $50 in cash and a certificate, and a Student prize of $25 in cash and a certificate, as provided by the conditions of the establishment of the awards.

II. The Junior award shall be open only to members in good standing in the grade of Junior in the Society.

III. The Student award shall be open only to members in good standing of the Student Chapters of the Society.

IV. The award of a prize may be made to a former Junior who since the presentation of his paper has been transferred to the grade of Associate Member. Also, the award of a prize may be made to a former student who since the presentation of his paper has become a Junior in the Society.

V. The awards will be made on the basis of papers dealing with ethics, the subjects to be selected each year, for the succeeding year, by the Committee on Professional Conduct, presented before a Local Section, a Local Section Conference, a Student Chapter, or a Student Chapter Conference. The term "conference" shall include those at the time of a Society meeting or those which are regional in character.

VI. In any year when the excellence of more than one paper justifies it, the prize committee may designate a "second order of merit." A paper so recognized shall be considered eligible to compete in the award for the next succeeding year.

VII. The subject selected by the Committee on Professional Conduct shall be announced each year at the Summer Meeting of the Board of Direction and shall be published in the next issue of *Civil Engineering*.

VIII. Papers considered for the award shall not exceed one each from any Local Section, Local Section Conference, Student Chapter or Student Chapter Conference, as presented before that group during the year ending July 1.

IX. A paper may be presented by a person other than the author, but no person other than the author shall be considered as participating in the prize in the event of an award for that paper.

X. Papers written jointly by more than one author are not eligible.

XI. A Daniel W. Mead Prize shall not be awarded to the same person more than once.

XII. To be eligible for the award, papers shall not have appeared in print in other than a school, college or American Society of Civil Engineers' publication.

XIII. Length of papers shall not exceed 2,000 words.

XIV. All papers for entry in the competition shall be in the hands of the Executive Secretary of the Society not later than July 1 of each year.

XV. Immediately after July 1 of each year the Executive Secretary shall send to the Vice-President of each Zone all papers originating in that Zone. The Vice-President shall appoint a committee of members of the Society to select not more than two papers from that Zone for submission in the final competition. The papers so chosen shall be placed in the hands of the Executive Secretary of the Society by the Vice-Presidents not later than September 1 of that year.

XVI. Immediately after September 1 of each year the Executive Secretary shall submit to the Committee on Professional Conduct all competition papers received from Vice-Presidents of the Society. The Committee on Professional Conduct shall select the papers to receive the Junior and the Student prize awards, and will announce the results of the competition at the Fall Meeting of the Board of Direction, or not later than October 15.

XVII. Where practicable, the presentation of prizes will be made at a Local Section meeting, Local Section conference, Student Chapter meeting, or Student Chapter conference.

XVIII. These rules may be modified by the Board of Direction upon recommendation of the Committee on Professional Conduct.

Essays should be mailed directly to the Editor, Technical Publications, ASCE 33 West 39th Street, New York 18, N.Y.

Postcard Order Blanks for TRANSACTIONS Due

FOR those who have not yet returned the postcard order blank sent out from Society Headquarters last month with the notice that there will be a charge for ALL future copies of TRANSACTIONS, and that ALL volumes must be ordered individually, this is a reminder that the orders should be mailed NOW.

Those who have had standing orders for cloth or half-Morocco bound volumes of TRANSACTIONS need not return the cards, as their orders will continue to stand until canceled or altered in writing. However, those who have been receiving paper-bound volumes must enter a specific order, indicating preference for paper, cloth, or half-Morocco binding, and authorizing that their accounts be charged in accordance with their expressed preference. Charges are $2.00 for paper bindings, $3.00 for cloth, and $4.00 for half Morocco.

Once these new orders are received, they too will be considered standing orders until further notice is received in writing. No TRANSACTIONS will be printed without an order.

For foreign members, additional time is being allowed for receipt of mail beyond the October 10 deadline, which had to be established in order to facilitate billing.

Delay Eliminated in Delivery of Badges

SOCIETY badges for Juniors and Student Chapter members, frequently unavailable during the war, may now be had without delay. There is still some delay in getting the Corporate Member badges engraved, but the time required is decreasing and it is expected that the situation will soon be normal.

Badges are priced as follows:

Corporate Member, $5.00, plus 20% federal tax

Junior, $2.00, plus 20% federal tax

Student Chapter Member, $1.00, plus 20% federal tax

Badges desired for Christmas gifts should be ordered as promptly as possible to ensure delivery in time.

Sacramento Summarizes Members' War Records

By R. Robinson Rowe, M. ASCE

Having followed closely the fortunes and misfortunes of its 149 members absent in military service, the Sacramento Section is compiling a personal summary of that service for publication in its 1946 Year Book. If the Sacramento group in military service is considered as a 2% sample of the Society as a whole, an impersonal statistical account may be of general interest to the other Sections.

As previously reported (Civil Engineering, December 1944), the Section's monthly *Engineerogram* was the basic means of communication with members in service, and every effort was made to see that the absent member received his copy. More than 1,100 personal notes appeared in the *Engineerogram*, and in addition there were five annual directories. As with address changes, fewer than one-third of these squibs were obtained directly from the member. The best sources were friends and relatives, and these were catalogued for inquiry whenever a returned *Engineerogram* told of a change or when six months had elapsed without news.

To verify and complete these notes for the war history of the Section, a questionnaire was sent out last February. The personal summaries being published will abstract all the information in abbreviated form. A 7-year correlation of the Section make-up with the number in service is shown in Fig. 1, but the correlation may be misleading without some explanation.

"Assigned membership" is determined once a year by the Society by means of a

Table I. Number of Members in and out of Service in Each Grade

	Army			Navy and Marine		
	Grade	In	Out	Grade	In	Out
1	Pvt.	22	2	S	9	0
2	NCO	4	8	NCO	6	3
3	2nd Lt.	12	5	Ens.	30	7
4	1st Lt.	17	4	Lt. jg	20	18
5	Capt.	10	22	Lt.	7	28
6	Maj.	7	16	Lt. Comdr.	4	13
7	Lt. Col.	1	13	Comdr.	0	7
8	Col.	0	3	Capt.	0	0
	Totals	73	73		76	76
	Mean of group	3.2	5.1		3.4	4.8

rule which excluded those who reported service addresses or "permanent addresses" of relatives outside the Section area. It was Section policy to retain these in "total membership," since most of them were on military leave from civil employment in the area. That this policy was reasonable is proved by two trends on the chart: (1) the climb of "subscribing membership" above "assigned membership" in 1943, and (2) the reduction of

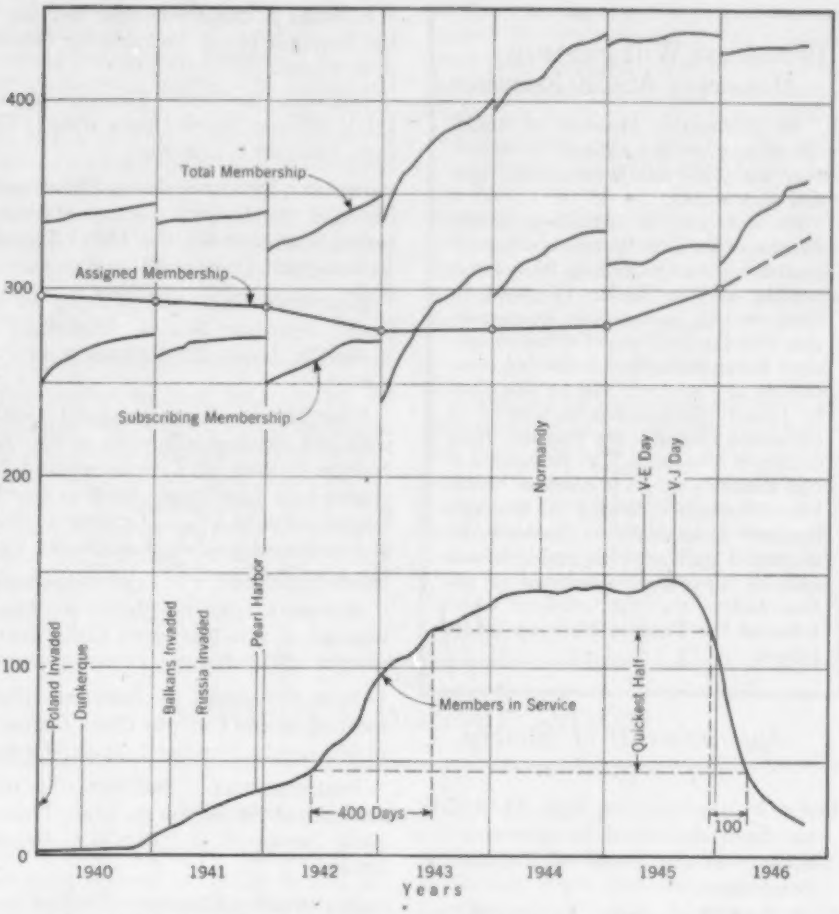


Fig. 1. Membership Record of San Sacramento Section Charted

non-subscribing membership (the difference between "total" and "subscribing") in 1946 to the prewar number.

The best correlation is between "total membership" and "members in service," from which, using maxima, 149 out of 435, or 34%, of the Section entered military service.

The lower curve shows that there was little recruitment of engineer officers after January 1944 and that the peak nearly coincided with the dropping of the atomic bombs just before V-J Day. Recruitment was most rapid in the 400 days from May 1942 to June 1943, when half the group entered. In contrast, this "quickest half" was released in just 100 days, or four times as quickly.

The concern of the Section over the civil reemployment of members returning from military service led to the appointment of a Reemployment Committee, which sent out a questionnaire to survey the extent and nature of the problem. The Committee found that 80% had positions waiting for them and that most of the others had entered the service directly from college.

So far the Reemployment Committee has served by answering general questions through the columns of *Engineerogram* and particular questions by correspondence. There is considerable demand for civil engineers in the Sacramento area, and all veterans asking for assistance have been placed immediately. The Committee expects a scarcity of good jobs and a greater demand for reemployment service in about two years. It reported one unusual consequence of the

Table II. Decorations Received by 149 Members in Service

Legion of Merit	3
Bronze Star Medal	8
Air Medal with 9 Clusters	1
Navy and Marine Corps Medal	1
Purple Heart	4
Distinguished Unit Citation	1
Army Commendation Ribbon	5
Good Conduct Medal	1
Presidential Unit Citation	7
Meritorious Service Award	2
Foreign	4

liberality of California legislation extending leave privileges ex post facto to its former civil service employees. One who left for service in 1917 and remained in the Army until his retirement in 1944 was reemployed in his old grade.

The Section feels well repaid for its efforts by the marked tendency of returning members to take part in Section activities. Attendance at the semi-social weekly technical meetings is well over 100, compared with a prewar 78, and the trend of subscribing membership has already been noted.

Broadcast Will Feature Honorary ASCE Member

AN HONORARY Member of ASCE will be featured in a national broadcast over the Columbia Broadcasting system next month.

He is Gerard H. Matthes, retired director of the U.S. Waterways Experiment Station at Vicksburg, Miss., now residing in New York. His work in flood control, particularly in connection with the large model of the Mississippi River Basin that is nearing completion at Vicksburg will be described by John E. Pfeiffer, science director of Columbia Broadcasting System, from 6:15 to 6:30 p.m., E.S.T., November 5. Mr. Pfeiffer's program is called "Frontier of Science." During the Society's Summer Convention at Spokane, he devoted a portion of his weekly broadcast to the papers presented at the Convention on the studies which followed the Tacoma Narrows Bridge failure.

Appointments of Society Representatives

BORIS A. BAKHMETEFF, Hon. M. ASCE, has been appointed to represent the Society on the Board of Engineering Foundation.

VAN TUYL BOUGHTON, M. ASCE, has been appointed to represent the Society on Engineers Council for Professional Development, succeeding R. E. BAKENHUS.

W. W. HORNER, President ASCE, has been appointed to succeed Past-President E. B. BLACK as Society representative on the John Fritz Medal Board of Award for a four-year term ending September 30, 1950.

HAROLD M. LEWIS, M. ASCE, has been appointed a Society representative on the Board of the Engineering Societies Library.

News of Local Sections

Scheduled Meetings

ALABAMA SECTION—Joint dinner meeting with the Alabama Polytechnic Institute Student Chapter at Alabama Polytechnic Institute, Auburn, October 18.

CINCINNATI SECTION—Meeting in the Engineers Society Building, Cincinnati, October 2, at 8 p.m.

COLORADO SECTION—Dinner meeting at the Oxford Hotel, Denver, October 14, at 6:30 p.m.

FLORIDA SECTION—Dinner meeting at the Seminole Hotel, Jacksonville, October 3, at 7 p.m.

ILLINOIS SECTION—Meeting at the Little Theater (Civic Opera Bldg.), Chicago, October 1, at 8 p.m.

INDIANA SECTION—Joint dinner meeting with the Indiana Society of Professional Engineers at the Hotel Lincoln, Indianapolis, October 23, at 6 p. m.

KENTUCKY SECTION—Meeting at the Speed Scientific School, University of Louisville, Louisville, October 4, at 7:30 p.m.

NEW MEXICO SECTION—Joint meeting with the Student Chapter at the New Mexico College of Agriculture and Mechanic Arts, Las Cruces, October 4 and 5. Registration at 5 p.m., October 4; dinner and technical meeting, Las Cruces, October 4, at 7:30 p.m.

NORTHEASTERN SECTION—Dinner meeting at the Engineers Club, Boston, October 28, at 6 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Campus Club, University of Minnesota, October 7, at 6:30 p.m.

PHILADELPHIA SECTION—Technical meeting at the Engineers Club, Philadelphia, October 8, at 7:30 p.m.; dinner at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club, Sacramento, every Tuesday at 12 m.

SAN FRANCISCO SECTION—Regular dinner meeting at the Engineers Club on October 15, at 6 p m.

TENNESSEE VALLEY SECTION—Fall meeting at the Hotel Patten, Chattanooga, November 8 and 9.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel, Dallas, November 4, at 12:15 p.m.

Recent Activities

ALABAMA SECTION

Students from the University of Alabama and the Alabama Polytechnic Institute swelled the attendance at the late summer meeting of the Section, which was held in Montgomery. Several technical papers were read during the afternoon meeting, and the evening session consisted of a dinner and talk by J. E. Hannum, dean of engineering at the Alabama Polytechnic Institute. Developing the subject, "The Place of the Engineer in Life," Dean Hannum referred to a recent survey made by a committee of the American Society for Engineering Education, indicating a demand for 337,000 engineers in this country by 1950. Corroborating this finding, Dean Hannum stated that all the activities of the postwar world will require many more engineers than are now available, and predicted a glowing future for the profession.

CENTRAL ILLINOIS SECTION

The Section met with the Champaign County section of the Illinois Society of Engineers on September 5, at the invitation of the University of Illinois Student Chapter. The program, which had been arranged by the Chapter, consisted of an eye-witness account of the atomic bomb tests at Bikini Atoll, by Prof. Wilbur M. Wilson, Society Director and representative of the Society at the tests. Professor Wilson described his reaction to the explosion and discussed the development of atomic power in relationship to world peace.

METROPOLITAN SECTION

Both recreational and technical interests were served by the summer meeting of the Junior Branch. Through the courtesy of the Dorr Company, about fifty members of the Branch and their guests journeyed to near-by Westport, Conn., the site of the Dorr Research Laboratory. Occupying the site of an early American grist-mill, the laboratory has facilities for conducting a great variety of sanitary and hydraulic tests, and a conducted tour of these facilities proved exceptionally interesting. In addition to the tour, picnicking, canoeing, swimming, soft ball, and other agreeable activities featured the outing. Largely responsible for the success of the occasion was the new president of the Junior Branch, Charles Knapp, one of the Dorr Company engineers.

MID-SOUTH SECTION

More than sixty delegates from five states attended the summer meeting of the Mid-South Section, which was held in Little Rock, Ark., in August. A paper on problems of engineering education—written by G. P. Stocker, dean of the college of engineering at the University of Arkansas—was read by Prof. W. R. Spencer and discussed by Lee H. Johnson, dean of the engineering college at the University of Mississippi, at the morning session. Pointing out that "the question of who should go to college is a very pertinent one at this time when the advisers of the returned veterans are recommending that everyone go," Dean Stocker stated himself to be of the belief that it is a serious mistake to encourage young men without aptitude or preliminary training for higher education to go to college just because they are veterans. Other speakers heard during the day included Col. G. E. Galloway, district engineer for the U.S. Engineer Office at Little Rock, who outlined the Corps of Engineers new program of developing recreational uses out of flood-control reservoir areas; and J. R. Henderson, assistant engineer for the Arkan-

sas State Highway Department, who discussed new traffic routes needed to relieve the internal traffic situation in Little Rock. A banquet concluded the day's festivities, the principal speaker being J. N. Rutledge, Fort Smith consultant, who related his engineering experiences with the Army Air Forces overseas.

Panama Section

The principal speaker at a recent meeting of the Panama Section was Francis X. Kerr, of the Office Engineering Division of the Panama Canal. Mr. Kerr discussed the use of reinforced concrete in the construction of oil-storage tanks on the Isthmus, stressing the waterproofing aspects of concrete for such construction.

Puerto Rico Section

A talk on "The Engineer and the Theory of Scientific Management"—presented at a recent meeting by Dr. Juan B. Ortiz—proved so interesting to the Section that it has arranged to sponsor a series of lectures on the theory of administration. Dr. Ortiz, who will present the lectures during the fall, recently returned from the United States where he studied the subject. He is a former dean of the college of administration at the University of Puerto Rico, and the university is cooperating with the Section in sponsoring the series.

Sacramento Section

The development and testing of electrical equipment for all types of highway vehicles was discussed by Daniel Finch at a recent meeting. Mr. Finch is at the University of California, in charge of the laboratory that tests electrical equipment and accessories for the State Highway Patrol. On another occasion, Edwin H. Slosson, manager of the John W. Stang Corporation, presented a motion picture showing how the well-point system is used to keep excavations dry during construction work. The present and potential use of jet propulsion in aviation was described at a third luncheon meeting by Maj. James G. Haizlip, who returned to review and expand his remarks made at an earlier meeting this year.

San Francisco Section

Some of the problems confronting the public health engineer today were discussed by Frank M. Stead at a recent meeting of the San Francisco Section. Formerly with the State Department of Health as a senior industrial hygiene engineer, Mr. Stead is now chief of the recently organized Division of Environmental Sanitation of the Department.

At a meeting of the Junior Forum William H. Brady, consulting engineer and lecturer in the college of engineering at the University of California, spoke on "An Example of More Effective Engineering Instruction." Mr. Brady, who has pioneered in the field of visual aids in engineering instruction, illustrated his talk with a sound film, entitled "Fundamentals of Land Surveying." Arnold Olitt, chairman of the meeting, was replaced on the Rotating Committee by Robert C. Levy. John N. Henderson is the new chairman of the Membership Committee, succeeding David Pirtz. The Forum is planning to resume the seminar courses preparatory to the civil engineers' licensing examinations in the fall.

South Carolina Section

The annual summer meeting of the Section took the form of a joint gathering with the South Carolina Society of Engineers. The meeting was held in Charleston, and a Friday afternoon trip to the plant of Charleston the water works inaugurated the program. Later there was a business meeting, and a dinner and dance at the Fort Sumter Hotel had been arranged for the evening. The principal after-dinner speaker was R. M. Figg, legal representative of the South Carolina State Port Authority, who gave a talk on the Charleston Port Terminal. On Saturday morning the group went by boat up the Ashley River to visit the terminal. Interesting aspects of the trip were a river view of the Charleston Navy Yard and the Port of Embarkation. A luncheon, served to the members at Sullivans Island, concluded the program.

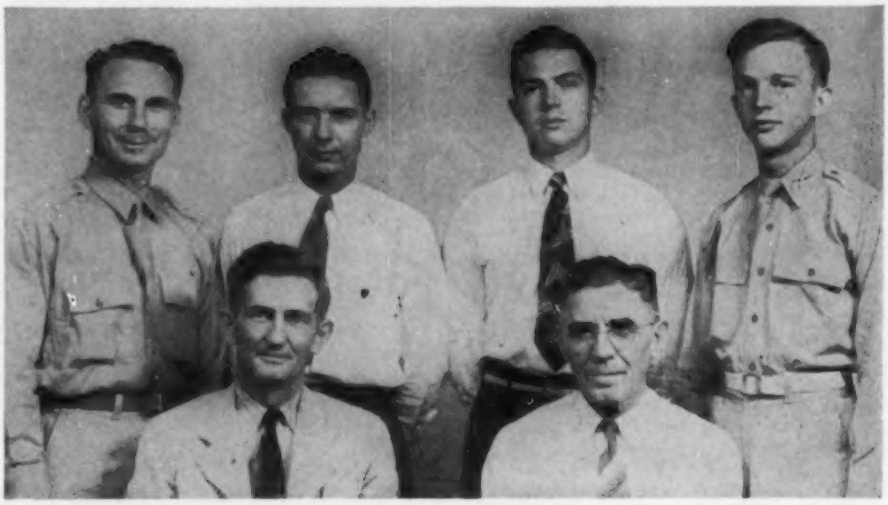
Texas Section

Numerous business matters were discussed at the August luncheon meeting of the Fort Worth Branch of the Section. Guest of honor and principal speaker appearing on the technical program was Dr. Burke Brewster, director of public health and welfare for the city of Fort Worth, who spoke on the timely topic of poliomyelitis.

Student Chapter Notes

Agricultural and Mechanical College of Texas

Anticipating a record enrollment in engineering courses at Texas A. and M. this fall, the Student Chapter has been making extensive plans for a banner year. A recent "get acquainted" social for students and faculty members, sponsored by the Chapter, was a great success. The newly elected officers who will direct Student Chapter affairs during the coming year are: M. Drahn Jones, of Dallas, president; Marshall W. Amis, of Fort Worth, vice-president; Loren H. Stiles, of Celina, secretary; and William C. Ely, of Mineral Wells, treasurer. This group, together with Faculty Advisers Spencer J. Buchanan and Carl E. Sandstedt, are shown in the accompanying photograph. At the present there are 75 active members in the organization, but it is expected that this number will be tripled with the beginning of the fall term. About 60% of the organization is composed of veterans who have returned to college to complete their studies.



Officers and Faculty Advisers of the Texas A. and M. Chapter
Reading Left to Right (Standing): M. Drahn Jones, president; Marshall W. Amis, vice-president; Loren H. Stiles, secretary; and William C. Ely, treasurer. Seated: Spencer J. Buchanan and Carl E. Sandstedt, Faculty Advisers

About Engineers and Engineering

Consulting Board Begins Panama Canal Study

ASCE Members Advocate "Policy of Protection"

A POLICY "fully protective of the national interests" in the light of "prospective improvements in guided missiles and in the size and power of explosive units," has been recommended by a Board of Consultants composed of ASCE members making a revaluation of the Panama Canal.

Selected pursuant to Public Law 280 passed by the 79th Congress, the ASCE members who recently made their first trip to the Isthmus, and issued their initial recommendation for the protective policy after consultation with officials there, are:

Admiral Ben Moreell, Chief of the Material Division of the Navy Department; Prof. Boris A. Bakhmeteff of Columbia University; Brig. Gen. Hans Kramer, formerly supervising engineer of the Special Engineering Division; W. H. McAlpine, of the Office of the Chief of Engineers; Hibbert M. Hill, consulting engineer of Minneapolis; and Joel D. Justin, consulting engineer of Philadelphia.

After hearing reports and data on all phases of the present studies, as presented by Col. James H. Stratton, M. ASCE, Canal Supervising Engineer, the Board of Consultants issued the following statement as it began its studies:

"The ultimate objective of the current studies is to establish secure lines of communications for our armed forces and the supporting national economy in time of war or of national emergency. Provision of such lines of communications for emergency service will automatically take care of the needs of peacetime commerce.

"Recent developments in the matériel of offensive warfare have served to increase the relative importance of the time element in the mobilization and deployment of the nation's resources when war threatens and after hostilities have commenced. For this purpose, secure and easy lines of communication have acquired vastly increased importance. The prospective improvements in guided missiles and in the size and power of explosive units would indicate an acceleration in the increase in importance of the time element mentioned above.

"What is the significance of these considerations to the problem in hand? No one can foresee the exact lines of development of the new offensive weapons nor can one foretell now what will be the means of defense. We are now confronted with the necessity for early action in the choice of canals with respect to type and location but with incomplete knowledge of the conditions under which they would have to function. Under the circumstances, and in view of the tremendous importance to the national safety, prudence requires the adoption of a policy fully protective of the national interests. Experience during the past war and good judgment indicate the propriety of a plan of duplication and dispersion of vital works.

"What about the costs? While *relative* costs in *time* and *money* should be considered, the money costs should not become a governing consideration. A nation with a national income of $150 billions per annum (considered to be a proper figure for the stabilized postwar economy) cannot hesitate over the expenditure of two or three billions when its very existence is being weighed in the balance. Of equal importance is the significance of these canals in the plans of hemisphere defense which has received so much public notice lately.

"In the development of plans for the new canal or canals, we should have in mind certain basic considerations—among others

(*a*) At no stage of the operations should we have *less* canal capacity than at present;

(*b*) The canal capacity should be increased as quickly as possible to accommodate the largest naval vessels;

(*c*) At no stage should the security of the canal either from a structural or military point of view be less than at present;

(*d*) The sequence of operations should be such that work could be terminated at any time without jeopardizing the capacity or security of the canal."

BOARD OF CONSULTING ENGINEERS MEETS WITH PANAMA CANAL OFFICIALS

Left to Right: Joel D. Justin, M. ASCE, Consulting Engineer of Philadelphia; Hibbert M. Hill, M. ASCE, Consulting Engineer of Minneapolis; Brig. Gen. Hans Kramer, M. ASCE, Corps of Engineers, U.S.A.; Col. James H. Stratton, M. ASCE, Supervising Engineer of the Special Engineering Division; Governor Mehaffey of the Canal Zone; W. H. McAlpine, M. ASCE, of the Office of the Chief of Engineers, Washington, D.C.; Admiral Ben Moreell, Hon. M. ASCE, Chief of the Material Division, Navy Department; Dr. Boris A. Bakhmeteff, Hon. M. ASCE, Professor of Civil Engineering, Columbia University, New York

American Welding Plans Full Program for Annual Meeting

A TOTAL of 80 technical papers scheduled for 24 sessions in 15 divisions of the welding field—that is the program prepared for the 27th Annual Meeting of the American Welding Society, to be held in Atlantic City, N.J., at the Hotel Ambassador, November 17–22.

Subjects to be covered include welding research, resistance welding, pressure welding, cutting, weldability, railroad applications, electrodes, production welding, pressure vessels and storage tanks, machinery, shipbuilding, aircraft, structural welding, hard facing, and high alloys. There will also be papers on the arc welding of cast iron with nickel electrodes, flame-hardening, and plant maintenance.

ACI Issues Manual on Reinforced Concrete Design

IMPROVED methods and standards for preparing drawings for the fabrication and placing of reinforcing steel are presented in a recent publication of the American Concrete Institute, entitled "Proposed Manual of Standard Practice for Detailing Reinforced Concrete Structures." This 56-page manual is the final result of the work of Committee 315 of the ACI, which was organized in 1940 to prepare a report on the detailing of reinforced concrete structures in cooperation with the Concrete Reinforcing Steel Institute.

Believing that the proper preparation of engineering and placing drawings requires a general knowledge of the entire procedure from the design stage to the time the reinforcing steel is placed, the committee has divided the procedure into the following three parts: (1) Designing, including the preparation of the engineering drawings to show the size and reinforcement of the members and other information necessary for the proper interpretation of the designers' ideas; (2) detailing, consisting of the preparation of placing drawings, reinforcing bar details and bar lists, which are used for the fabrication and placement of the reinforcement in the structure; and (3) fabricating, consisting of the actual work on the reinforcing steel. Typical engineering and placing drawings are also shown to illustrate the use of the standards.

Those desiring to purchase the manual should get in touch with the American Concrete Institute, New Center Building, Detroit 2, Mich. The price is $2.50 to nonmembers.

ASCE Members Take Part in Paris Technical Congress

Several members of ASCE participated in the preparation of the program of the International Technical Congress, held at the Maison de la Chimie in Paris, September 16 to 21. Professor Frederick B. Farquharson of the University of Washington's Civil Engineering Department, was the Society's official representative at the meeting. The presentation was arranged to "reveal American engineering philosophy as typified by American accomplishments," by the United States committee for the Congress. Col. William N. Carey, Executive Secretary of ASCE, was the Society's representative on this committee, although he did not make the trip to France for the meetings. The congress was composed of delegates from most of the United Nations. The United States committee included representatives from five national engineering societies: ASME, ASCE, AIME, AIEE, and AIChE.

Part I of the American program dealt with general engineering problems of reconstruction. Among those preparing papers was Dr. Joseph W. Barker, M. ASCE, president of the Research Corporation, New York, whose subject was "Applied Scientific Research." The feature of Part II was an address on nuclear energy by Harry A. Winne, vice-president of the General Electric Company, Schenectady.

Part III, on "The Present Situation of Engineering in the United States," included contributions from two ASCE members: Harold M. Lewis, consulting engineer of New York, whose subject was "Town Planning," and Maj. Gen. Philip B. Fleming, Administrator, Federal Works Administration, Washington, D.C., on "Civil Engineering and Public Works." Part IV, dealing with "Engineers in the United States," also included contributions from two ASCE members: L. E. Grinter, vice-president of the Illinois Institute of Technology, Chicago, on "Technical Education and Professional Training"; and Prof. R. D. Mindlin, of Columbia University's Department of Civil Engineering, on the "Activities of the Society for Experimental Stress Analysis."

Conference on Hydraulic Machinery Is Scheduled

A two-day National Conference on Hydraulic Machinery, intended to foster an interchange of ideas, methods of approach, and techniques in the field of hydraulics, will be held at the Hotel Continental in Chicago, October 22 and 23. Sponsored by two divisions of the Illinois Institute of Technology, Armour Research Foundation and the Graduate School, with the cooperation of the Western Society of Engineers and local sections of the ASCE, the ASME, and the SAE, the 1946 conference is the second annual meeting.

Four technical sessions have been scheduled, at which papers covering fundamental aspects and recent developments in the field will be presented. The list of speakers includes V. L. Streeter and R. A. Dodge, both members of the Society. A third member—Hunter Rouse, director of the Iowa Institute of Hydraulic Research—will give the featured address on turbulence at the dinner meeting on October 22.

Those planning to attend are urged to register in advance by mail. A check for $13.50, which will cover the cost of all conference activities, must accompany all advance registration, and should be sent to the conference secretary, O. I. Teichmann, Armour Research Foundation, 35 West 33rd Street, Chicago 16. General inquiries should be addressed to V. L. Streeter at the same address.

Fatigue Testing Machine Built for Northwestern University

By L. T. Wyly, M. ASCE

Professor of Structural Engineering and Head of Department, Purdue University, West Lafayette, Ind.; Formerly Associate Professor of Civil Engineering, Northwestern University

A new large fatigue or repeated-load testing machine, believed to be the largest in the country, was recently completed at Northwestern University. Its capacity in direct stress is from 250,000 lb in tension to 250,000 lb in compression (a total range of 500,000 lb) and about 1,000,000 in.-lb in either reversed torsion or bending. Torsion and bending may also be combined in any desired ratio. The machine can make independent tests on two specimens simultaneously. It is 25 ft long, 9 ft high, 7 ft wide and has a total weight of 60,000 lb. It is mounted on leaf springs to avoid transmission of vibration to the building.

The machine operates on the lever principle and the load application follows a sine wave. The normal speed of loading is about 3 cycles per sec, or a quarter of a million cycles per 24-hour day, but for heavier loads this speed is reduced. Electric resistance wire gage (SR4) readings on the specimen during operation show no appreciable dynamic effect on the loading.

The machine was designed and detailed and its construction supervised by the writer. It is modeled after the well-known fatigue testing machines at the University of Illinois, which were designed, developed, and used over the past 25 years by Prof. Wilbur M. Wilson, Director, ASCE. Professor Wilson generously gave Northwestern University the benefit of his advice and experience in this work. Manufacture and construction were effected by using the combined services of a number of firms in the region as well as the services of the Northwestern University mechanics.

The machine will be used, together with the University of Illinois machines, on the investigation of riveted and bolted joints soon to be initiated by the research council of riveted and bolted joints, which is now being organized by Profs. C. A. Ellis, G. A. Maney, T. C. Shedd, and Wilbur M. Wilson, all members of ASCE.

The first specimens tested in the new machine were two riveted joints furnished through the sponsorship of the American Institute of Bolt, Nut and Rivet Manufacturers. The joints were identical except that one was connected with hot driven rivets and one with cold driven rivets. Both failed after less than 70,000 cycles of fully reversed stress of 20,000 lb per sq in. on the net section. Failure was by brittle fracture through the net section of the plates. These results are similar to those which were obtained by Professor Wilson at Urbana some years ago

Northwestern's New Fatigue Testing Machine

U.S.G.S. Issues New Map Covering Wyoming Area

A GEOLOGIC MAP of an area of about 1,300 sq miles in the southern part of the Wind River basin and adjacent areas in central Wyoming has been issued by the Geological Survey. The map, which has been in administrative use in the Survey for many years, has been made available to the public because of the current interest in oil and gas possibilities in this part of Wyoming.

It is a westward extension of Preliminary Map 51 of the Geological Survey's Oil and Gas Investigations series, which was recently published. Like Map 51, it was originally prepared on the basis of field investigations made in 1913–1914 and has been published essentially in its original form. Subsequent changes in formation names are shown by a stratigraphic section that compares present usage with that prevailing at the time the map was made. Highways, county lines, and locations of oil and gas fields have been added.

Published on a single sheet measuring 28 by 32 in. and titled "Geologic map of the southern part of the Wind River basin and adjacent areas in central Wyoming," it has been issued as Preliminary Map 60 of the Oil and Gas Investigations series. Copies may be purchased from the Director of the Geological Survey, Washington 25, D.C., at 30 cents each. Copies will be available also for over-the-counter sale at Geological Survey field offices at the Federal Building, Casper, Wyo.; at Room 314, Boston Building, 828—17th Street, Denver, Colo.; and at Room 234, Federal Building, Tulsa, Okla.

39 States Approve PRA's Integrated Highway Net

PROSPECTS are bright for an integrated highway system, planned for fast-moving traffic between all cities of one-hundred-thousand population or more. Development of the federal-aid system, as planned by the Public Roads Administration, eventually will provide two-lane, four-lane, and in some instances six-lane routes connecting all cities of this size, as well as most of those in the 10,000-to-100,000 population class.

Development of a 40,000-mile interstate highway system was authorized by the Federal-Aid Highway Act of 1944, and the states were asked in 1945 to recommend routes for inclusion in the system. The routes selected by the state highway departments totaled 45,074 miles, but included some duplicate mileage and more than 2,000 miles of circumferential and distributing routes in urban areas.

After reviewing these routes, which in some instances involved disagreements between adjoining states as to connections at state boundaries, or the proposal of alternate routes within a state, the PRA prepared a tentative integration of the system and offered it to the states for approval. This system as recommended by PRA includes 37,170 miles between and across cities, leaving a remainder of 2,830 miles within the 40,000-mile statutory limitation. This reserve is considered sufficient for the later selection of circumferential and distributory routes in urban areas, which are not included in the 37,170 mileage.

Thirty-nine states and the District of Columbia have accepted without reservation the integration by the PRA of the routes proposed by the states to form the national interstate highway system. Of the nine remaining states, four desire alteration of the proposed system. Two of these accepted a part of the routes in the tentative integration but rejected certain sections without alternative proposal. Another state did the same except that it proposed additional mileage. One state accepted the proposed system in its entirety but requested the inclusion of additional routes. Five states have not yet responded to the recommendations. According to Commissioner Thomas H. MacDonald, Hon. M. ASCE, the prospect of early agreement with most of the nine states "is not discouraging."

No specific appropriation for the development of the interstate system was authorized by the Federal-Aid Highway Act of 1944, but it did provide for an annual appropriation of $225,000,000 in each of three fiscal years for improvements to the federal-aid system, and $125,000,000 for highway projects of the system in urban areas. Since the proposed integrated system will automatically become a part of the federal-aid system, these funds will be available for expenditure on it.

Motion Pictures Are Loaned by Bureau of Reclamation

THOSE willing to pay express charges both ways can obtain from the U.S. Bureau of Reclamation 16-mm motion pictures relating to its activities. The list of available films follows:

Boulder Dam	5 reels (silent)
Boulder Dam	4 reels (sound)
Reclamation in the Arid West	1 reel (sound)
Fundamentals of Irrigation	3 reels (sound)
Irrigated Pastures (Kodachrome)	2 reels (sound)
Fighting Weeds (Kodachrome)	3 reels (sound)
Measurement of Water (Kodachrome)	3 reels (sound)

Films are distributed by the Bureau of Reclamation, Washington 25, D.C.

Ohio Board Issues Report on Water Resources

A MIMEOGRAPHED report on "The Water Resources of Fayette County, Ohio," is now available as Bulletin No. 2 in the projected series on the water resources of Ohio counties being made by the Ohio Water Resources Board. This 54-page preliminary report is intended to give a general picture of the water resources of the county and other factual information relevant to an inventory of the water resources of an area. As additional data are collected by the Board, preparation of a more detailed report will be undertaken.

The entire series is being prepared under the general direction of C. V. Youngquist, Assoc. M. ASCE.

Reclamation Bureau Prints Maps of Western Projects

FOUR maps of projects in the Western part of the United States are now available from the Bureau of Reclamation, as follows:

Western Half of the United States showing Reclamation projects and the 7 regions. Map No. 44-14, revised October 1945. Size 16 × 20 in., free.

Orland Project, California, Map No. 45-45 (supersedes No. 21880). Blue, green, and black. Size 8 × 10 1/2 in., price 10 cents.

Grand Valley Project, Colorado, Map No. 45-40 (supersedes Nos. 23888 and 23888A). Green, brown, blue, and black. Size 16 × 26 in., price 25 cents.

Klamath Project, Oregon–California, Map No. 45-52 (supersedes Nos. 27450 and 27450A). Black, blue, green, and red. Size 16 × 20 in., price 20 cents.

Postage stamps should not be sent in payment for maps ordered. Checks or money orders should be made payable to the Treasurer of the United States, and orders should be addressed to the Commissioner, Bureau of Reclamation, Department of the Interior, Washington 25, D.C.

New in Education~

VPI Gets New Facilities for Veterans' Educational Program

APPLICATION by the Virginia Polytechnic Institute for war surplus buildings to be used as laboratories, drafting rooms, a cafeteria, a physical education and recreation building, and a reconditioned athletic field, has been approved by Maj. Gen. Philip B. Fleming, M. ASCE, Federal Works Administrator, under the Veterans Educational Facility program.

The additional facilities will enable VPI eventually to accommodate 3,500 students, of which 2,500 will be veterans. Recently dormitory space at the Radford Ordnance Works has been obtained to house about 500 veterans. The additional facilities approved are designed to take care of the educational needs of this increase.

* * * *

Johns Hopkins Opens New Sanitary Engineering Lab

FOR graduate study and research in sanitary engineering and water resources, a new Sanitary Laboratory has been opened in the Department of Sanitary Engineering, Johns Hopkins University. The new laboratory facilities will be used especially for studies of the chemistry and biology of water supplies, sewage disposal systems, polluted waters, industrial wastes, and the ecology of estuaries. Courses offered will complement those by Abel Wolman, M. ASCE, Professor of Sanitary Engineering, and Associate Professor J. C. Geyer, Assoc. M. ASCE, by furnishing formal and research training in the bacteriological, biological, and chemical techniques basic to sanitary engineering.

A unique feature of the work is the extension of facilities for mutual study of water resources problems by those interested in conservation, waterways improvement, shellfish, and other fields involved in the control of public waters. The new laboratories will be in charge of Dr. Charles E. Renn, lately Associate Biologist of the Massachusetts Department of Public Health and lecturer in sanitary biology at Harvard.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. ASCE

"NOAH, since your problem involves buoyancy and since I have overheard a dispute over the proper unit for expressing 'rated buoyancy,' I wonder if you'd let me read a definition I found on a recent quiz paper?"

"Gladly," said Professor Neare.

"Here it is, then," continued Professor Scrubal. "'Buoyancy is what Archie Meade found in a bathtub in Eureka so that they didn't arrest him when he went downtown

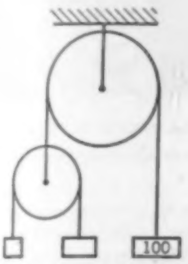


FIG. 1. PULLEY SYSTEM

without his bathrobe. I never saw one because we have a shower.' I rated that buoyancy with an F—."

"That's a severe penalty for honesty. Let's see how Joe Kerr found the rated buoyancy of the life preservers made by the Atta Buoy Co."

"Joe didn't, but he nearly did," said Joe. "I reviewed buoyancy and found the rating for a ship was Plimsoll's Mark, for a lifeboat the number of persons it could take aboard, and for cork 46–54 lb per cu ft in fresh water. So I let x be the rated buoyancy in pounds per cubic feet, w the weight of stuffing A in lb per cu ft, and d the cost of A in cents per lb, and set up these equations:

$$x = 62.4 - \frac{w}{27}(a + 2b + 3c) = 64 -$$

$$\frac{w}{27}(b + 2c + 3a) = 72 - \frac{w}{27}(c + 2a + 3b)$$

$$a + b + c = 27$$

"That gave me four equations in five unknowns. When I tried to get a fifth from equality of cost, the unknowns all canceled out. Operating on the 4, I could get only 2-unknown relations like these:

$$15x = 992 - 30w; \quad 5a - b = 36; \quad w(a - 9) = 14.4\text{"}$$

"Joe's done all the hard work," exclaimed Cal Klater. "Maybe he forgot that a, b, and c must be integers. From his last relation $a > 9$; if we try $a = 11$ in the second, we get $b = 19$. Since $a + b$ cannot exceed 27, we are limited to $a = 10$, $b = 14$, $c = 3$, $w = 14.4$, and $x = 37^1/_3$. That is, if the life preservers displaced 1 cu ft, the lifting power would be $37^1/_3$ lb for Model F in fresh water, for Model O in the ocean, and for Model S in Great Salt Lake."

"Just so," agreed the Professor. "Now that Joe and Cal have disposed of the old problem for me, I'm going to keep right on loafing and let Isidore Knobbe officiate again as Guest Professor."

"Mine won't be an integer teaser, Noah, but the boys will have to watch out for redundants," warned Professor Knobbe. "Figure 1 shows a familiar weightless, frictionless pulley system supporting three unequal weights. Most texts on kinetics require computation of the motion of known weights, but I think the corollary more vexing. What are the weights if, 10 sec after the system is released, all three are moving with the same momentum?"

[Only one Cal Klater this month, the Guest Professor Isidore Knobbe (Joseph S. Lambie). Also acknowledged is a correct solution to last month's mirror problem from May B Masce (J. S. Kendrick), late but alibiing with a Canadian postmark.]

Progress on Basic Building Code Reported at Meeting

MEMBERS of ASCE played a prominent part in the Thirty-First Annual Meeting of the Building Officials Conference of America, Inc., at which building code reform was the dominant theme. The meeting was held in the Hotel Peabody, Memphis, Tenn., from September 30 to October 3.

One of the highlights was the progress report of the National Basic Building Code

GEORGE E. STREHAN, M. ASCE, WHO CONTRIBUTES TECHNICAL GUIDANCE TO NATIONAL BASIC BUILDING CODE COMMITTEE

Committee, under the chairmanship of Albert H. Baum, M. ASCE, Building Commissioner of St. Louis, Mo. The basic code has been in preparation for two years by a group of outstanding code administrators representing various sections of the country. This work has progressed under the technical guidance of George E. Strehan, M. ASCE, consulting engineer of New York. He reported on technical problems relating to the basic code and reviewed developments.

Three other ASCE members, all from New York, contributed to the program: Arthur J. Benline, Borough Superintendent, Department of Housing and Buildings, City of New York; J. R. Burkey, chief consulting engineer, Union Metal Manufacturing Company; and Harry T. Immerman, chief engineer, Spencer, White and Prentis, Inc.

CED Calls for Postponement of Public Works Construction

POSTPONEMENT of federal disbursements for public works so that inflation can be curbed is being urged by the Committee for Economic Development. In its "Statement on National Policy" issued September 22, the Committee claimed that "every dollar of public works outlay means more competitive bidding for existing resources and more inflationary pressure." Also listed as inflationary factors were large military expenditures absorbing about 40% of the 1947 federal budget, veterans' pensions and benefits estimated at 5.8 billion dollars for 1947, and general federal administrative expenditures.

In actual dollars involved, the public works program is a small factor in federal expenditures. Yet in terms of competition for materials and labor, every dollar exerts its inflationary pressure. The statement of CED continues:

"The composition of the public works program reflects an appraisal of the economic picture that was current in the fall of 1945. It was then recognized that building materials—brick, lumber, etc.—would be in very short supply, but it was thought that there would be room and need for public works of a type that did not use such materials, such as reclamation, flood control, roads, and rural electrification.

"But the fact is that all resources, including labor, are scarce today and every dollar of public works outlay means more competitive bidding for existing resources and more inflationary pressure. In view of conditions as they have actually developed, some steps have already been taken to screen and cut the public works program. All possibilities for further action in this field should be explored. We shall have opportunity, and perhaps need, at some later date to carry out any worthwhile projects that are postponed today."

This national policy statement was prepared by the Research and Policy Committee of CED.

NEWS OF ENGINEERS

Personal Items About Society Members

STANLEY T. BARKER, captain, Naval Civil Engineer Corps, has returned from Peru, where he served for three years as public works officer in the U. S. Naval Aviation Mission to the Peruvian Air Force. He was awarded the Cruz Peruana de Aviacion for his work in improving the airports of Peru. He is now in his former post in the Division of Sanitation of the New York State Department of Health.

JOHN K. VENNARD is now in the department of civil engineering at Stanford University. He was previously associate professor of fluid mechanics at New York University.

W. G. MORRISON, who recently returned from overseas service as a lieutenant colonel in the New Zealand Engineers, is establishing himself in practice as a civil and structural engineer in association with the architectural firm of Mitchell and Mitchell, Wellington, N.Z.

EMORY W. LANE
Returns to Staff of Bureau of Reclamation

EMORY W. LANE has returned to the U.S. Bureau of Reclamation as hydraulic consultant on the Chief Engineer's staff. He was associated with the Bureau from 1929 to 1935, leaving there to become professor of hydraulic engineering at the University of Iowa. More recently he was on the staff of the Hydraulic Laboratory at the University of Iowa.

MARK M. FALK has become a member of the newly formed architectural and engineering firm of Franklin, Kump and Falk, with offices in San Francisco.

RODNEY F. COLTART, recently released from the Army Sanitary Corps, has returned to the Link-Belt Company as engineer for the sanitary engineering division in Eastern sales territory. His headquarters will be at the company's Philadelphia plant.

MELVIN F. WOOD is now assistant chief engineer of the Du Pont Company in Wilmington, Del. Mr. Wood has been with the Du Pont Company since 1928, and for the past year has been manager of the design division of the engineering department.

HUGUENIN THOMAS, JR., and JOSEPH J. HUTTON have established the consulting firm of Thomas and Hutton, with headquarters in Savannah, Ga. Mr. Thomas was previously district engineer for the U.S. Engineer Office at Savannah, and Mr. Hutton district engineer at Miami, Fla. The new firm will specialize in engineering planning, surveys and mapping, and reports.

LAWRENCE T. SMITH is en route to China, where he will make a survey for UNRRA of the bridge construction required to rehabilitate Chinese railroads. Colonel Smith served overseas during the recent war and was seriously wounded in the invasion of Sicily. Prior to entering the service, he was for many years bridge engineer for the Chicago Park District.

LEWIS D. ASMUS has been released from active duty as a lieutenant colonel in the Army Corps of Engineers and has returned to the Public Roads Administration as design engineer on the staff of the district engineer, with headquarters in Jefferson City, Mo. Colonel Asmus' last tour of duty consisted of the preparation of a report on the extent of wartime damage to the Philippine highway system.

THOMAS R. AGG has retired as dean of engineering at Iowa State College. Because of heavy wartime schedules at the college, Dean Agg remained at his post three years beyond the customary age limit for retirement. He has served the Society as Director and Vice-President.

JOHN H. MELVIN is now district geologist for the U.S. Engineer Office at Omaha, Nebr., where he will be engaged in the geological engineering phases of the Missouri River Development program. He was formerly geologist and treasurer for the Pennsylvania Drilling Company, Pittsburgh, Pa.

HAYWOOD G. DEWEY, JR., now on terminal leave as a major in the Corps of Engineers, has returned to the Clinton, Miss., sub-office of the U.S. Waterways Experiment Station to continue as a civilian in the position he held during the war. As engineer-in-charge, he will direct construction of the 200-acre Mississippi Basin Model and the administration of the Clinton reservation. Prior to entering the military service, Mr. Dewey was with the U.S. Bureau of Reclamation in Denver.

JOHN B. WILBUR, professor of structural engineering at Massachusetts Institute of Technology, has been appointed head of the department of civil and sanitary engineering. Professor Wilbur has been on the staff of the Institute since 1930, and has been acting head of the department since the death of THEODORE B. PARKER two years ago.

ARTHUR A. SAUER, following service as a commander in the Navy Civil Engineer Corps, has established a structural engineering practice in Sacramento, Calif. For his wartime service as assistant superintending civil engineer of Area VII, Mr. Sauer was recently awarded a citation and commendation ribbon from the Secretary of the Navy.

WILLIAM EARL WELLER, director of the Rochester (N.Y.) Bureau of Municipal Research, is one of two new members recently elected to the board of trustees of the Citizens Public Expenditure Survey of New York State.

GRAEME REID, following his discharge from the Navy Civil Engineer Corps, in which he was a commander, will resume his civil engineering practice, with temporary headquarters in Essex Fells, N.J. He will specialize in government administration of construction contracts and highway transportation regulation. A branch office in Washington, D.C., is planned.

CARL M. HOSKINSON, for many years chief engineer of the Sacramento (Calif.) Water Department, has been appointed to the additional post of superintendent of the department.

FRANKLIN F. SNYDER
Receives Civilian Service Award

FRANKLIN F. SNYDER is a recent recipient of the War Department's Exceptional Civilian Service Award for outstanding wartime service in the European Theater of Operations as hydraulic engineer attached to the Office of the Chief of Engineers. His citation reads in part, "His unusual ability and application to duty as forecaster with the Rhine River Flood Prediction Service, European Theater of Operations, constituted a valuable aid to the success of military operations." Mr. Snyder presented a paper on the "Rhine River Flood Prediction Service" at the 1946 Annual Meeting of the Society. A native of Toledo, Ohio, he is at present stationed in Washington.

JUNIUS T. MOORE has been appointed to the State Registration Board for Professional Engineers of West Virginia. Mr. Moore is president of the Fireproof Products Company, Charleston, W.Va.

JOHN L. MASON, until lately a commander in the Navy Civil Engineer Corps, is now associated with the engineering office of CLYDE C. KENNEDY, in San Francisco. Before entering the Navy in 1941, Mr. Mason specialized in pre-stressed concrete construction.

A. A. KALINSKE, formerly associate professor of hydraulics and associate director of the Iowa Institute of Hydraulic Research at the University of Iowa, has accepted the position of chief hydraulic engineer of Infilco, Inc., with headquarters in Chicago, Ill. During the war Mr. Kalinske acted as special consultant to the Navy on fluid mechanics problems, in addition to his work at the university.

HENRY L. JACQUES is retiring as head of the major construction division of the Los Angeles Water and Power Department after almost thirty-five years of service. He has been in the department since 1910, except for a period in the Army Engineer Corps during the first World War, and he has been head of the major construction division since 1919.

CLYDE P. NICHOLSON, formerly head transportation analyst for the Foreign

How a B-G Asphalt Plant Provides "Intermediate" Mixing

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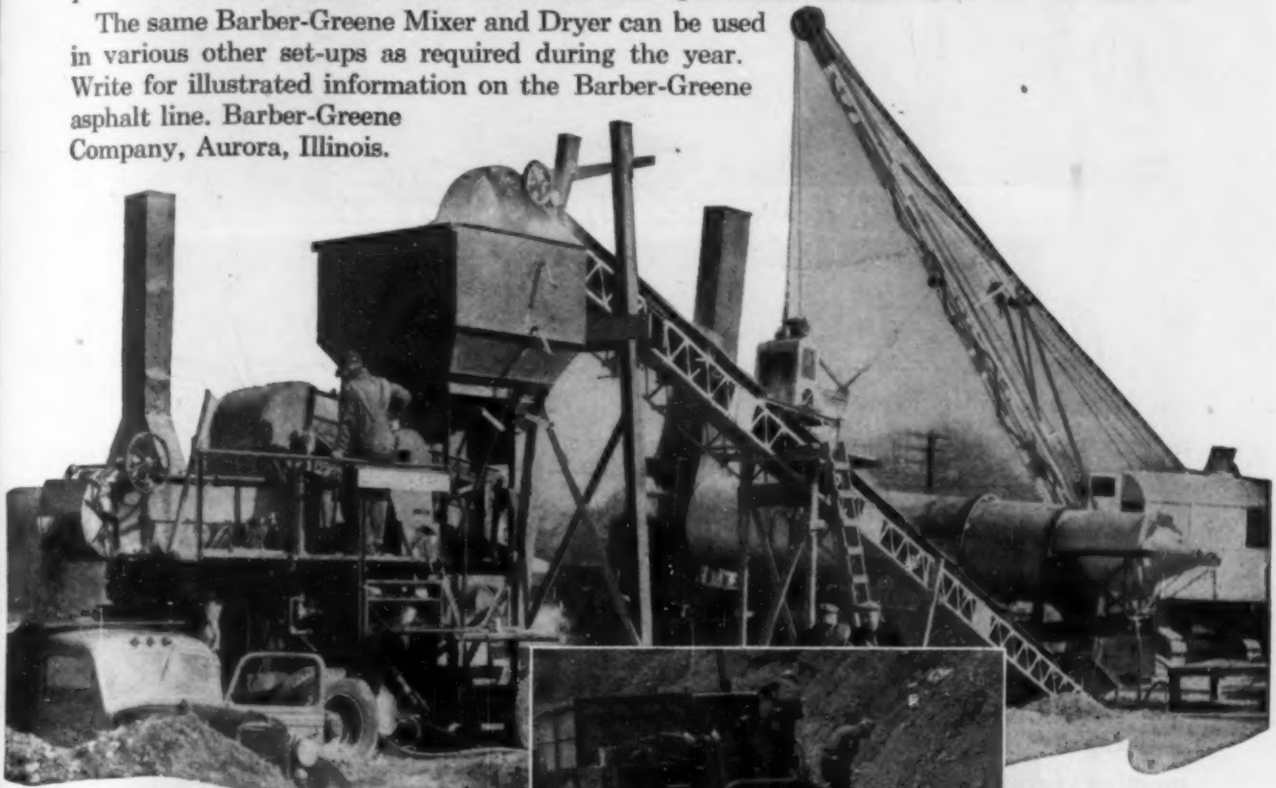
Moisture content—responsible for the failure of many secondary pavements—is positively controlled by the B-G Intermediate Plant. In addition, use of heavier bitumens is permitted, producing a higher quality surface than can be obtained with road mix. And frequently at comparable cost. Temperature control gives this B-G plant a wide range of application, from road mix types to high quality asphaltic concretes. High capacity and low erection costs make high quality pavements possible on roads formerly restricted to mixed-in-place surfaces.

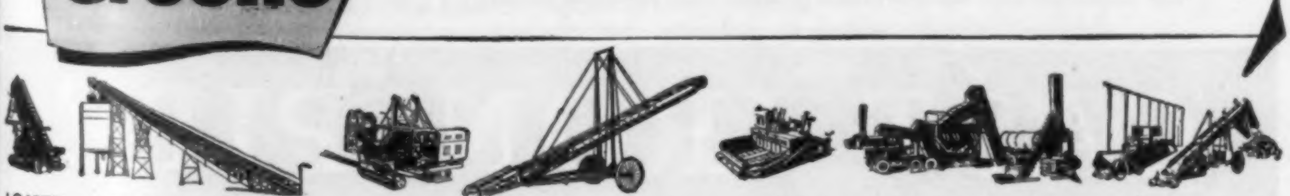
The same Barber-Greene Mixer and Dryer can be used in various other set-ups as required during the year. Write for illustrated information on the Barber-Greene asphalt line. Barber-Greene Company, Aurora, Illinois.



Tamping, leveling, and automatically striking off simultaneously, the B-G Finisher accurately measures the amount of paving material and maintains uniform depth.

46-10

Barber-Greene CONSTANT FLOW EQUIPMENT



Economic Administration, is now supervising engineer of Virginia Beach, Va. Mr. Nicholson recently returned from Paris, where he was adviser to the American embassy on transportation.

George K. Leonard, for the past two years chief of the project planning division of the Water Control Planning Department of the Tennessee Valley Authority, has been made project manager in charge of the South Holston and Watauga projects. Mr. Leonard has been connected with TVA since 1933.

James H. Dowling, previously state highway engineer of Florida, has accepted a position with the Florida Equipment Company, with headquarters in Tallahassee.

Sterry J. Mahaffey is now executive secretary of the Virginia Road Builders Association. Until lately he was city manager of Durham, N.C.

Charles R. Little, who was recently released from the Army Field Artillery, has been appointed executive secretary of the Ohio Valley Conservation and Flood Control Congress.

Linton E. Grinter has resigned as dean of the graduate school at the Illinois Institute of Technology to become research professor of civil engineering mechanics. He is representing the Institute at the International Mechanics Congress being held in Paris this fall.

Joseph F. Friedkin, after four years with the Army Engineer Corps, assigned to the Mississippi River Commission, has resumed his duties as hydraulic engineer with the International Boundary Commission. He is in the branch office of the Commission established in San Diego, Calif., for the handling of Colorado and Tijuana River problems. Mr. Friedkin had the rank of major at the time of separation from the service.

Horatio M. Fitch has accepted an appointment as assistant professor of theoretical and applied mechanics at the University of Illinois. Formerly on the staff of the university, he has recently been assistant professor of civil engineering at the University of Arizona.

Herbert H. Wheaton, since 1942 research associate in the radiation laboratory at Massachusetts Institute of Technology, has returned to his position as associate professor of mathematics and engineering at Fresno State College, Fresno, Calif. Professor Wheaton, who has studied abroad as one of the Society's Freeman Scholars, left his post at Fresno four years ago to work on radar research at M.I.T.

Irvin A. Cooper is now on the staff of the Charleton Laboratories, analytical and consulting chemists of Portland, Ore., where he will be in charge of the testing of construction materials. Mr. Cooper was formerly in the marine pipe department of the Kaiser Company in Portland.

William L. Sawyer has resumed his position as associate professor of civil engineering at the University of Florida after several years of wartime service as a commander in the Navy Civil Engineer Corps.

Clark Kittrell, division engineer, Upper Mississippi Valley Division, St. Louis, Mo., was recently awarded the Distinguished Service Medal. Colonel Kittrell has served the Corps of Engineers in various assignments in this country and abroad.

Col. Clark Kittrell
Recent Recipient of the Distinguished Service Medal

His latest overseas assignment was in Cairo, Egypt, from which he returned in the fall of 1945. Honors previously awarded him include the Legion of Merit Medal, the Oak Leaf Cluster to the Legion of Merit, and the Bronze Star Medal. He also holds the Croix de Guerre with Palm from the French government.

Marion D. Ross recently resigned as district engineer for the Kentucky State Highway Department at Covington to become executive secretary of the Plantmix Asphalt Industry of Kentucky, with offices at Frankfort.

Fritz Zapf, previously senior civil engineer for Alameda, Calif., has accepted an appointment as city engineer and superintendent of streets for the city of Redondo Beach, Calif.

Lawrence T. Wyly has resigned as associate professor of structural engineering at Northwestern University to become professor of structural engineering at Purdue University. In his new capacity he will succeed Charles A. Ellis, who is retiring after twelve years as professor of structural engineering.

Thomas G. Harton has become associated with the U.S. Bureau of Reclamation, in Washington, D.C., following his release from wartime service as a lieutenant colonel in the Army Corps of Engineers.

George Gillette, colonel, Army Corps of Engineers, has been appointed acting director of the South Atlantic Division of the Corps of Engineers. He was formerly district engineer at Wilmington, N.C.

Randolph P. Hoelscher, professor of general engineering drawing at the University of Illinois, will assume additional duties as associate dean of the college of engineering.

Herbert Moore is reopening his engineering office in the Pereles Building, Milwaukee, Wis., after three years overseas in the Army Sanitary Corps.

Lynn W. Pine, colonel, Army Corps of Engineers, has been assigned to new duties as chief of the engineering division of the San Francisco District Engineer Office. He was previously aviation engineer representative at the Command and General Staff School.

Thomas R. Komline, who was recently released from the Army Sanitary Corps, has formed the Komline-Sanderson Engineering Corporation, with headquarters in Ridgewood, N.J. The organization will specialize in the design and construction of equipment for the final disposal of sewage sludge and industrial wastes.

Walter B. Little, major, Army Corps of Engineers, is now liaison officer for the Alaska District of the U.S. Engineer Office, with headquarters in Seattle.

Robert R. Ellis, Jr., who is on the staff of the Frederick Snare Corporation, was recently transferred from the managership of the Lima, Peru, office of the organization to Caracas, Venezuela, where he will be manager of the company's activities in Venezuela.

A. J. Armstrong, until lately in the design branch of the U.S. Engineer Office at Pittsburgh, Pa., has accepted a position in the special engineering division of the Panama Canal.

DECEASED

Albert Sears Crane (M. '01) consulting engineer for the J. G. White Engineering Corporation, of New York, died August 25 in Bar Harbor, Me., where he was on vacation. He was 78. Early in his career Mr. Crane served as assistant chief engineer for the Michigan Lake Superior Power Company; chief engineer for the Lake Superior Power Company; and principal assistant engineer with the Chicago Drainage Canal. Mr. Crane joined the staff of the J. G. White Corporation as a hydraulic engineer in 1905. He was named vice-president eight years later, serving in that capacity until 1928, when he became consulting hydraulic engineer. During his long career Mr. Crane engaged in the construction of thirty large earth dams, sixty masonry dams, and numerous hydroelectric and irrigation projects.

Gerald Henry Hoffman (Assoc. M. '38) major, Army Corps of Engineers, died in the Philippines in May 1942 while a prisoner of the Japanese, according to word which has just reached the Society. Major Hoffman, who was 37, has been posthumously awarded the Silver Star for gallantry in action in the Battle of Bataan. As division engineer, he planned and supervised the construction of mine fields along the entire division front while constantly under enemy fire. Major Hoffman had been in the Army since his graduation from Washington Uni-

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versity in 1930. He was stationed at various posts in the United States, and in April 1941 was sent to the Philippines.

JOSEPH THOMAS KIERNAN (M. '30) of Brooklyn, N.Y., was drowned August 20 at Ogunquit, Me., where he was vacationing. Mr. Kiernan, who was 55, had been on the staff of Ford, Bacon and Davis, New York engineers, since 1935. Earlier he was with the Philadelphia firm of Day and Zimmerman, and at one time was valuation expert for the Lehigh Valley and the Boston and Maine railroads. During the first World War Mr. Kiernan served overseas in the Army Transportation Corps.

SAMUEL WEST LAMBORN (M. '30) assistant engineer in the Philadelphia Department of City Transit died at his home in Philadelphia on August 24, at the age of 63. Mr. Lamborn had been in the Department of City Transit since 1913—for a number of years as designing engineer. During this period he designed Philadelphia's elevated and subway cars and, at the time of his death, was working on plans for new, lightweight, air-conditioned subway cars.

THOMAS HENRY MCCARTHY (M. '45) acting district engineer for the U.S. Indian Irrigation Service, San Francisco, Calif., died on February 13, 1946, according to word just received at Society Headquarters. His age was 56. In 1920, following wartime service as a lieutenant in the Army Artillery Corps, Mr. McCarthy became superintendent of th Nebraska School of Irrigation. From 1923 to 1930 he was professor of civil engineering at the New Mexico School of Mines, and from the latter year to 1934 division engineer for the Middle Rio Grande Conservancy District. Since 1935 he had been in the Department of the Interior—for most of this period as supervising engineer for the Indian Irrigation Service.

EDWARD WARREN RITCHIE (M. '24) died in a hospital in Mt. Kisco, N. Y., on July 29, 1946, at the age of 71. Mr. Ritchie's engineering work took him to Mexico, South America, the Dominican Republic, and Costa Rica, where he was field engineer on the construction of the Guacimal hydroelectric plant. He was also engineer for the U.G.I. Contracting Company, of Philadelphia, on a design for the development of all unused power in the Housatonic River, Conn. From 1933 to 1941 he was with the Public Works Administration in charge of irrigation work in Montana, which included supervision of the design and construction of fourteen dams. More recently Mr. Ritchie had been with the Defense Plant Corporation in Akron, Ohio, and Litchfield Park, Ariz.

RAPHAEL HENRY VANDERBROOK (Assoc. M. '20) assistant chief draftsman for the Chemical Construction Corporation, New York City, died on August 13. He was 67. Early in his career Mr. Vanderbrook was with the New York Bureau of Engineering and the New York Public Service Commission. Later he taught at the College of the City of New York, and from 1923 to 1939 he was structural engineer and chief draftsman for the American Cyanamid Company of New York. In the latter year the engineering department of the Cyanamid Company was abolished, and its activities transferred to the Chemical Construction Corporation, a subsidiary organization.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From August 10 to September 9, 1946, Inclusive

ADDITIONS TO MEMBERSHIP

ANDREWS, DAVID RICHARD (Jun. '46), Student, Graduate School, Syracuse Univ. (Res., 245 Homecroft Road), Syracuse, N.Y.

ANTHONY, JOHN JASON (Jun. '46), Junior Structural Designer, Maurice A. Reidy, Cons. Engr., 101 Tremont St., Boston (Res., 141 Harvard St., Wollaston 70), Mass.

BABSON, JOHN CAPRON (M. '46), Asst. Project and Design Engr., Am. Viscose Corp., 35 South 9th St., Philadelphia, Pa.

BECHTEL, STEPHEN DAVISON, JR. (Jun. '46), (Lakeside Co.), 155 Sansome St., San Francisco (Res., 244 Lakeside Drive, Oakland 12), Calif.

BERKEL, CHARLES JOHN (Jun. '46), 1929 Terrace St., Muskegon, Mich.

BROWN, HERBERT CLARK (Jun. '46), Jun. Engr., Robinson and Steinman, Cons. Engrs., 117 Liberty St., New York City (Res., 94-11 Eighty-sixth Rd., Woodhaven 21), N.Y.

BROWN, WILLARD HULL (Jun. '46), Student, Ohio State Univ., 80 Thirteenth Ave., Columbus 8, Ohio.

BURNS, ROBERT VALENTINE (M. '46), Divisional Irrig. Engr., Irrig. Dept., Ceylon Govt. (Res., 31 Brownrigg Rd.), Colombo, Ceylon.

BUSCHEN, HENRY ANTON (Affiliate '46), Vice-Pres., Thompson-Starrett Co., Inc., 444 Madison Ave., New York 22, N.Y.

BUTLER, ROBERT IMMELL (Jun. '46), Structural Draftsman, Mississippi Valley Structural Steel, 3117 Big Bend, Maplewood (Res., 7537 Dale, Richmond Heights), Mo.

CARLSON, HARRY ALBIN (Assoc. M. '46), Asst. Hydr. Engr., U.S. Geological Survey, Box 139, Bryson City, N.C.

CARRIERE, JEAN PAUL (Assoc. M. '46), City Mgr. and Chf. Engr., Corp. of City of Hull, City Hall, Hull, Quebec, Canada.

CHALKER, WILLIAM RANDOLPH (Jun. '46), Ensign, U.S.N.R.; Route 4, Box 408-J, Jacksonville, Fla.

CHAPMAN, ERSKINE CLIFFORD (Jun. '46), Field Engr., Caterpillar Tractor Co. (Res. 301 North Sheridan), Peoria, Ill.

CHOW, MING CHENG (M. '46), 629 West 115th St., New York 25, N.Y.

CORBIN, RALPH JAMES (Jun. '46), Insp., Fire Ins., State Inspection Bureau, Starks Bldg. (Res., 205 Kenwood Drive), Louisville, Ky.

COVERT, JOHN FRANCIS (M. '46), Civ. and Hydr. Engr., 3004 Laurel St., San Diego 2, Calif.

CRENSHAW, CARLTON (M. '46), Branch Sales Mgr., Gibbs Equipment Div., Gibbs Corp., P.O. Box 136, Maitland, Fla.

DASCENZO, ROBERT WILLIAM (Jun. '46), Junior Civ. Engr., Army Engrs., Pittock Block (Res., 3967 South East Lincoln St.), Portland 15, Ore.

DAVIS, JOHN PRINCETON (Assoc. M. '46), Hydr. Engr. (P-3), U.S. Engr. Dept., Room 513 Gibbs Inman Bldg. (Res., 671 South 37th St.), Louisville, Ky.

DE MONTIS, MARIANO ENRIQUE (Assoc. M. '46), Highway Engr., U.S. Public Roads Administration, Apartado 26, Managua, Nicaragua.

DINGWALL, JAMES COLLIN (Assoc. M. '46), Urban Designing Engr., State Highway Dept., Hampshaw Bldg., Smith & Preston St. (Res., 3715 Rice Blvd.), Houston 5, Tex.

DUBIN, EUGENE ARTHUR (M. '46), Structural Engr., A. Epstein, Engr., 2001 West Pershing Road (Res., 5321 University Ave.), Chicago 15, Ill.

ELLINGSON, HAROLD GRANT (Jun. '46), Engr., U.S. Bureau of Reclamation, New Customs Bldg. (Res., 1379 South Lafayette St.), Denver, Colo.

FARRAR, CHAPMAN OSCAR (Jun. '46), Draftsman (Maps), Upham Engr. Co., East Line St., Tyler (Res., 7127 Day St., Dallas 17), Tex.

FOOTE, ROBERT WARREN (Jun. '46), Route 1, Box 169, Santa Paula, Calif.

GADZIK, JOHN STANLEY (Jun. '46), Engr., Eng. Dept., Chance Vought Aircraft, Stratford (Res., 327 Washington St., New Britain), Conn.

GARY, JESSE LEHMAN (M. '46), Dist. Engr. of Design, State Div. of Highways, P.O. Box 217, Edgemont Station (Res., 808 North 24th St.), East St. Louis, Ill.

HALLUM, JOHN STEWART (Assoc. M. '46), Structural Designer, State Highway Comm., State House (Res., 109 South Highland), Pierre, S.Dak.

HARPER, SAMUEL DELANO (Jun. '46), 323 West Evans St., Florence, S.C.

HASPERT, MATHEWS JOSEPH (Jun. '46), Engr., Whitman, Requardt & Associates, 1304 St. Paul St. (Res., 45 Glenwood Rd.), Baltimore 21, Md.

HAUGHTON, WILLIAM ROBERT (Jun. '46), Asst. Supt., Gifford Hill & Co., Inc., 412 Texas Bank Bldg. (Res., 4415 Hall St.), Dallas 4, Tex.

HELFGOTT, MEYER DAVID (Assoc. M. '46), Drainage Engr., Soil Conservation Service, U.S. Dept. of Agriculture (Res., P.O. Box 265), Georgetown, Del.

HELLAND, HENRY CLINTON (Assoc. M. '46), Regional Director, War Assets Administration, P.O. Box 1161 (Res., 668 N. Rodney St.), Helena, Mont.

HOPWOOD, ROBERT HENRY (Assoc. M. '46), Asst. Engr., Charles S. Whitney, Cons. Engr., 724 East Mason St. (Res., 3325 West State St.), Milwaukee 8, Wis.

HUNTER, ROBERT KENT (Jun. '46), Student, Univ. of Colorado (Res., 451 Washington St.), Denver, Colo.

IRELAND, EDWARD HARTMANN (Assoc. M. '46), 3021 Wayne Ave., Baltimore 7, Md.

JACK, RONALD ALEXANDER (Jun. '46), 333 Parkman Ave., Mount Vernon, N.Y.

JACOBS, BRUCE BOYNTON (Assoc. M. '46), Engr., Eng. and Operations Section, War Dept., U.S. Engrs., Manhattan Dist., Box E, Oak Ridge, Tenn.

JESSEN, HOWARD ELLSWORTH (Jun. '46), Graduate Student, Univ. of California, Berkeley (Res. 4530 Lasheart Drive, La Canada), Calif.

JOHNSON, LAWRENCE BOON (Jun. '46), Grad. Student in Civ. Eng., Univ. of Washington, 4720 Twenty-first N.E., Seattle, Wash.

JOHNSTON, CHARLES TAUTPHAUS (Assoc. M. '46), Constr.'s Mgr., Carson Constr. Co., 720 Helena Ave. (Res., Box 1153), Helena, Mont.

KELLER, CHARLES WALTER, IV (Jun. '46), Junior Engr., Black & Veatch, Cons. Engrs., 4706 Broadway, Kansas City 2, Mo.

KURRASCH, JOHN HAROLD (M. '46), Engr. (Chf. Projects Branch), U.S. Engr. Office, Gibbs-Inman Bldg., 9th & Broadway (Res., 505 Cumberland Apts.), Louisville 2, Ky.

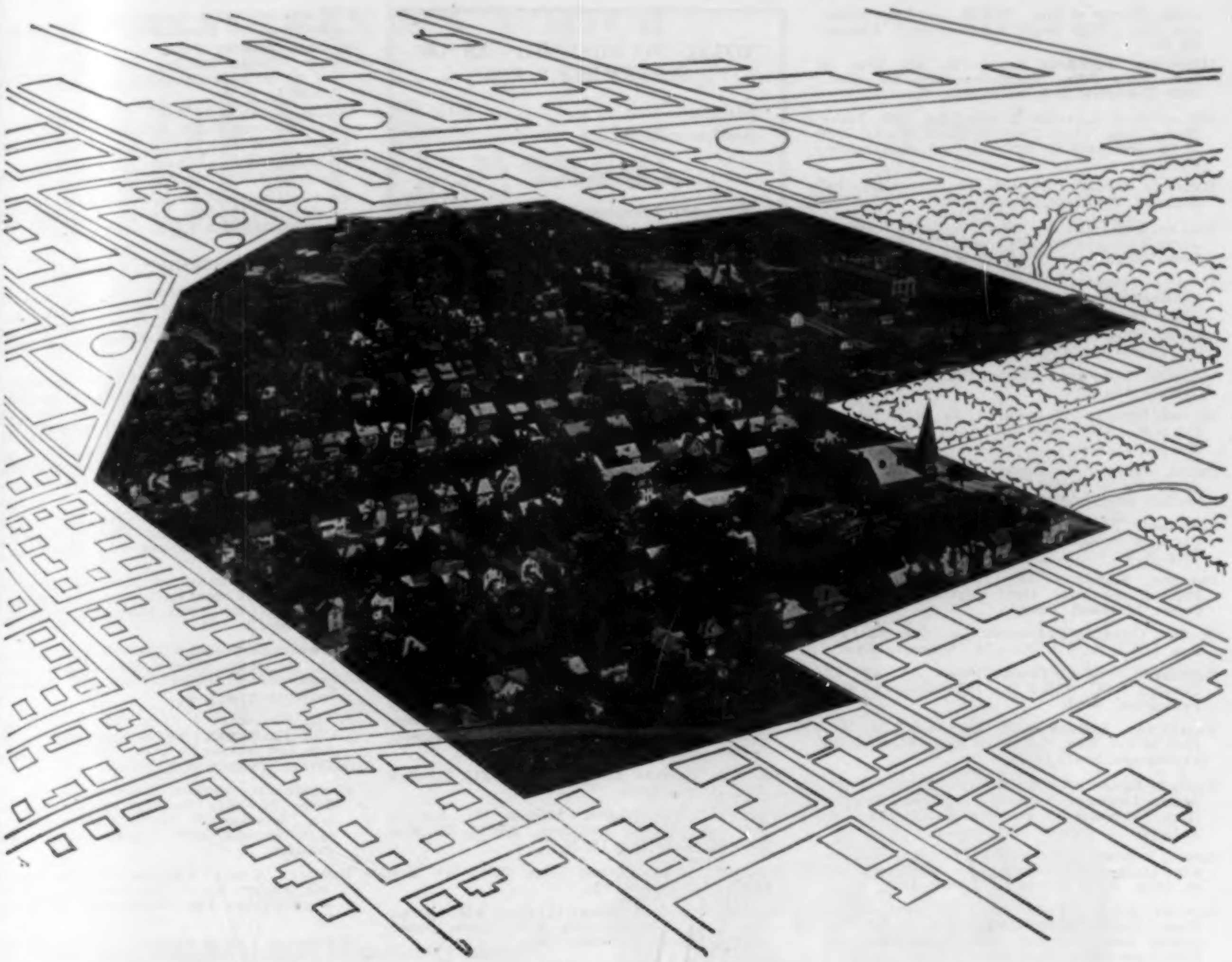
LANDRY, KENNETH FRANCIS (Assoc. M. '46), Engr. in Chg. of all field operations, Benham Eng. Co., 550 Am. National Bldg. Oklahoma City, Okla.

LINDHOLM, CORNELIUS, JR. (Jun. '46), Eng. Trainee Socony-Vacuum Oil Co., Inc., 41 River St., East Rutherford (Res., 1095 Alicia Ave., West Englewood), N.J.

LUTTRELL, JOSE ROBERTA, JR. (Jun. '46), Municipal Engr., Direccion de Obras Publicas Provinciales, P.O. Box 1449, Ancon, Canal Zone.

MCCUTCHEN, ALBERT CARROLL (Assoc. M. '46), Associate Topographic Engr., U.S. Geological Survey, Box 133, Rolla, Mo.

MCILVAINE, WILLIAM DUFFIELD, JR. (Assoc. M. '46), Filtration Mech. Engr., So. Dist. Filtration



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MCLAUGHLIN, CHARLES ELMER (Jun. '46), Junior Bridge Engr., State Dept. of Public Works, 1120 N St. (Res., 888 El Dorado Way), Sacramento, Calif.

MEIXNER, GEORGE DONALD, JR. (Jun. '46), 117 Argonne Ave., Long Beach, Calif.

MILLER, LEO (Jun. '46), Stress Analyst, Goodyear Aircraft Corp., Dept. 28, Plant A, 1210 Massillon Road (Res., 684 Inman St.), Akron 6, Ohio.

MORGAN, PHILIP ROYAL, JR. (Jun. '46), Draftsman, Bethlehem Steel Co. (Res., 336 San Benito Ave.), San Francisco, Calif.

MORTON, BEN LINCOLN (Jun. '46), 552 North 8th St., Enid, Okla.

MORROW, LAWRENCE SMITH (Jun. '46), Excelsior Springs, Mo.

MYHRE, STUART HERBERT (Jun. '46), Ensign, U.S.N.R., 16216 Eleventh Ave., S.W., Seattle, Wash.

PALTA, BODH RAJ (Assoc. M. '46), Executive Engr., Public Works Dept., Public Works Dept. Section (Res., 80 Mall), Lahore, Punjab, India.

PAPPMEIER, JOHN HAROLD (Jun. '46), Pvt., Signal Corps, U.S. Army, Photo Center, Long Island City, N.Y.

PRESTON, KENNETH AL (Jun. '46), (Clarence Preston and Sons, Gen. Contr.), 1310 North Grove, Marshall, Tex.

QUIMBY, CHARLES FREDERICK, JR. (Jun. '46), Ensign, U.S.N.R., 416 Main St., Walpole, Mass.

RADCLIFFE, DONALD GREGG (Assoc. M. '46), Lt. Comdr., CEC, U.S.N.R., 1417 Gregory Way, Bremerton, Wash.

RAJARAMAN, SUNDARAM AIYAR (Assoc. M. '46), Prof. of Civ. Eng., College of Eng., Trivandrum, Travancore, South India.

RANDLE, FRANK RUSSELL (Assoc. M. '46), Engr., Armco Drainage & Metal Prod. Inc., Box 926 (Res., 841 South 5th East No. 6), Salt Lake City 2, Utah.

ROUSE, ROBERT DONALD (Jun. '46), Sales and Service, D. H. Rouse Roofing Co., 521 North 16th St. (Res., Rural Route 2), Quincy, Ill.

ROWLEY, LYLE BISHOP (Jun. '46), Architectural Engr., Public Works Dept., U.S. Naval Submarine Base, Rodman Canal Zone, Navy 121, Fleet Post Office, New York, N.Y.

SEYLER, JIMMY WARREN (Jun. '46), Field Engr., Merritt-Chapman & Scott Corp., Box 346, Green Cove Springs, Fla. (Res., 144 Washington Blvd., Centralia, Ill.).

SHEEHY, CYRIL EDWARD, JR. (Jun. '46), Constr. Engr., H. K. Ferguson Co., Box 488, Bucyrus, Ohio.

SHINGLE, JOHN HAYNE (Jun. '46), 2001 Lexington St., Houston, Tex.

TOTAL MEMBERSHIP AS OF SEPTEMBER 9, 1946

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Corporate Members	14,786
Honorary Members	36
Juniors	6,671
Affiliates	78
Fellows	1
Total	21,572
(September 10, 1945	21,052)

SNOW, GLENN WARREN (Jun. '46), Field Engr., Geo. A. Rutherford Co., 2752 Prospect Ave (Res., 19272 Coffinberry Blvd.), Cleveland 16 Ohio.

SPRITZER, ABRAHAM (Jun. '46), (Civ. Engr.), Junior Surveyor, Richmond Exploration Co., P.O. Box 93 (Res. P.O. Box 392), Maracaibo, Venezuela.

SVEDLUNG, JOEL EDMOND (Jun. '46), Junior Engr. (Structural), Bureau of Reclamation, Golden Eagle Bldg., 5th Floor (Res., 1620 Poplar St.), Denver, Colo.

SWISHER, JAMES MARK (Jun. '46), Vice-Pres., Mark Swisher Inc., 4500 Euclid (Res., 1381 East 84th St., Apt. 2), Cleveland, Ohio.

VICE, RAYMOND BROWNING (Assoc. M. '46), Associate Hydr. Engr., Water Resources Branch, U.S. Geological Survey, Box 90, Dickinson, N.Dak.

VIKUPITZ, EDWARD L. (Jun. '46), 2110 Linwood Ave., Toledo, Ohio.

WAGNER, ALLEN JOSEPH (Affiliate '46), Asst. to the Secy., Public Relations, ASCE, 33 West 39th St., New York 18, N.Y.

WALSTON, ELMER JAMES (Jun. '46), 816 East Sligh Ave., Tampa, Fla.

WARNER, BRAINARD HENRY III (Jun. '46), Apprentice Engr., Pennsylvania R.R., Care, Supervisor of Track, Wellsville, Ohio.

WATKINS, JOHN THOMAS (Jun. '46), Draftsman, Am. Bridge Co., Elmira Heights (Res., 249 Allen St., Elmira), N.Y.

WATSON, ROBERT GILES (Jun. '46), Tech. Service Engr., Universal Atlas Cement Co., 208 South La Salle St., Chicago, Ill.

WEAVER, WAYNE LOREN (Jun. '46), Research Graduate Asst., Univ. of Illinois, 207 Talbot Laboratory, Univ. of Illinois, Urbana, Ill. (Res., 1319 Second Ave., Boulder, Colo.)

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WIGAND, ROBERT CHARLES, JR. (Jun. '46), Civ. Engr., Callan Builders, Inc., 239 Great Neck Rd., Great Neck (Res., 610 Victory Blvd., Staten Island 1), N.Y.

WILLIAMS, LLOYD J. (Assoc. M. '46), Design Engr., Omaha Steel Works, 609 South 48th St. (Res., 4316 South 20th St.), Omaha, Nebr.

WILLIAMS, WALLA GLENN, JR. (Jun. '46), 3104 Edgewood Ave., Richmond 22, Va.

WILSON, JOHN MELVILLE (Jun. '46), Research Fellow and Student, Univ. of Washington (Res., 1508 Thirty-fifth Ave.), Seattle, Wash.

MEMBERSHIP TRANSFERS

BAXTER, SAMUEL SERSON (Jun. '26; Assoc. M. '35; M. '46), Projects Engr., Bureau of Eng. Surveys and Zoning, City of Philadelphia, 1100 City Hall Annex (Res., Kelvin Ave., Somerton), Philadelphia 16, Pa.

BENSCOTER, STANLEY URNER (Jun. '32; Assoc. M. '46), Aeronautical Engr., Bureau of Aeronautics, Navy Dept., Washington, D.C. (Res., A-12 Madison Bldg., Pres. Gardens, Alexandria, Va.)

BESSON, FRANK SCHAFFER, JR. (Jun. '35; M. '46), Brig. Gen., U.S. Army, Transportation Officer, Hq. AFPAC, Army Post Office 500, Care, Postmaster, San Francisco, Calif.

BRUDENELL, ROSS NYMAN (Jun. '33; Assoc. M. '46), Power Supply Engr., TVA, 804 Power Bldg. (Res., 702 South Moore Rd.), Chattanooga 4, Tenn.

CROWTHER, JAMES IRVING (Assoc. M. '40; M. '46), Staff Engr., Comm. on Governmental Efficiency & Economy, Inc., 900 Mercantile Trust Bldg., Baltimore 2, Md.

CRUMPACKER, HAROLD CHESTER (Jun. '34; Assoc. M. '46), Engr., Class 6, State Highway Comm., State House Annex (Res., 3852 Broadway), Indianapolis 5, Ind.

FOLTZ, FRANKLIN J. (Jun. '34; Assoc. M. '46), Chf. Draftsman, Allison Steel Mfg. Co., 19th Ave. and Jackson St. (Res., 1124 West Mackenzie Drive), Phoenix, Ariz.

HENRICKSEN, ARTHUR MONROE, JR. (Jun. '41; Assoc. M. '46), Designing and Res. Engr. Parsons, Brinckerhoff, Hogan & Macdonald, Apartado Nacional 2936, Bogota, Colombia, South America.

HOFFMAN, ROBERT FRANCIS (Jun. '39; Assoc. M. '46), Project Engr., The Pure Oil Co., 35 East Wacker Drive (Res., 1668 Farwell Ave.), Chicago, Ill.

HOLLERAN, LESLIE GILBERT, JR. (Jun. '33; Assoc. M. '46), Asst. Supt. of Constr., Turner Constr. Co., 420 Lexington Ave., New York (Res., 30 Eastchester Rd., New Rochelle), N.Y.

HUFF, GEORGE RUSSELL (Jun. '38; Assoc. M. '46), Civ. Engr., Eng. Div., Water Dept., 4th Floor, City Hall (Res., 7744 Grand), Kansas City, Mo.

IDEMA, JACOB JOHN (Jun. '33; Assoc. M. '46), Associate Hydr. Engr., U.S. Engr. Dept., Little Rock, Ark.

KENNEDY, JOSEPH MICHAEL (Jun. '35, Assoc. M. '46), Senior Civ. Engr., North Atlantic Div., U.S. Engr. Dept., 270 Broadway, New York 7, N.Y.

LAYTON, RAYMOND EDWARD (Jun. '39; Assoc. M. '46), Civ. Engr., International Eng. Co., Inc., P.O. Box 356, Denver, Colo.

LEWIS, JACK GEORGE (Jun. '38; Assoc. M. '46), Engr., Syska & Hennessy, 144 East 39th St., New York (Res., 163 Ocean Ave., Brooklyn 25), N.Y.

MACDONALD, ROBERT GEORGE (Jun. '33; Assoc. M. '46), 5845 Harold Way, Hollywood, Calif.

MARRA, JAMES VINCENT (Jun. '29; Assoc. M. '34; M. '46), Chf. Engr., Squad Leader, Hydr. Section Bureau of Sewage Disposal Design, Dept. of Public Works, City of New York, 125 North St., New York (Res., 25-72 Forty-fourth St., Long Island City 3), N.Y.

MARTIN, JOHN EDWARD (Jun. '39; Assoc. M. '46), Civ. Engr., Albert C. Martin & Associates, Archts. & Engrs., 333 South Beaudry, Los Angeles 13, Calif.

MATHIS, SAMUEL JACKSON (Jun. '40; Assoc. M. '46), Care, Raymond Concrete Pile Co., 140 Cedar St., New York 6, N.Y.

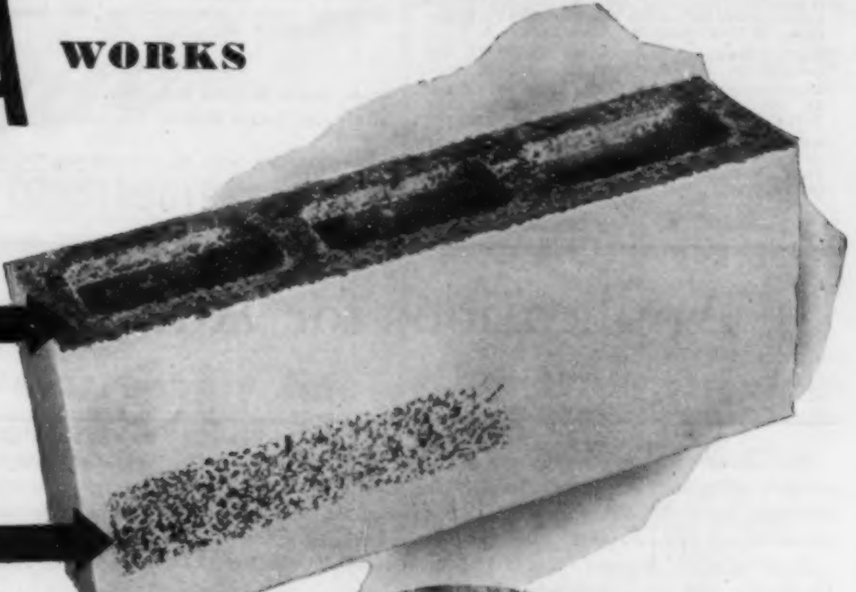
MCCLUSKEY, WILLIAM OLIVER, III (Jun. '36; Assoc. M. '46), Engr., Consolidated Eng. Co., 12th and Warren Sts. (Res., Box 409), Wheeling, W.Va.

OLMSTEAD, CARLOS BOYES (Jun. '38; Assoc. M. '46), Office Engr. Dept., Kanopolis Dam. Marquette, Kans.

PURDOM, PAUL WALTON (Jun. '38; Assoc. M. '46), Senior San. Engr., State Dept. of Public Health, 420 Sixth Ave., North (Res., 2115 Abbott Martin Rd.), Nashville 5, Tenn.

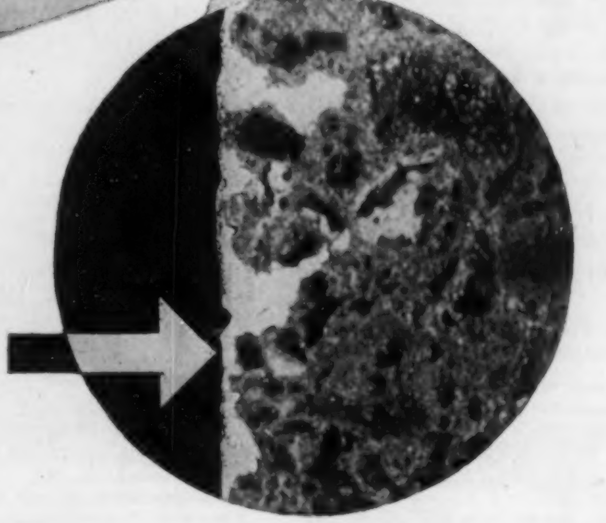
RIZZI, ANTHONY VINCENT (Jun. '37; Assoc. M. '46), Instr. in Civ. Eng. City College School of Technology, 140th St. and Convent Ave., New York (Res., 57 Walnut Ave., Floral Park), N.Y.

THE PRINCIPLE ON WHICH AQUELLA WORKS

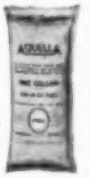


1 Here is an Aquellized concrete masonry unit filled with water. Naturally, there is no leakage.

2 But what happens if the Aquella surface coating is scraped off? To answer that, we scraped away this portion, and there's still no leakage. This may be slightly puzzling until you study the photograph of the third step...



3 The enlargement of a small, sawed-away section of the above block, which shows the way Aquella penetrates to fill and close each microscopic pore of the surface. It is the filling of the pores—not essentially the surface coating—which stops the penetration of water.



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Then—contrary to the shrinkage phenomena of most waterproofing materials—Aquella continues to *expand* as it cures to set up a hard, firm bond which stops water leakage, dampness or seepage.

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SAINT MALO, ALBERTO DE (Jun. '39; Assoc. M. '46), Prof. of Structural Eng., Universidad Interamericana, P.O. Box 1771, Panama, Panama.

SHILSTONE, HERBERT MAXWELL, JR. (Jun. '35; Assoc. M. '46), Pres., Shilstone Testing Laboratory, Inc., 301 M. & M. Bldg., Houston, Tex.

SIELKE, ALAN LEONARD (Jun. '42; Assoc. M. '46), Engr., James Stewart & Co., Inc., 230 Park Ave. (Res., 19 Stuyvesant St.), New York 3, N.Y.

STREETER, ROBERT LEROY (Assoc. M. '39; M. '46), Cons. Engr., P.O. Box 2010, Casper, Wyo.

TINNISWOOD, WILLIAM WALTER (Jun. '38; Assoc. M. '46), 1st Lt., San. Corps, U.S. Army Bldg. T-711, Oakland Army Base, Oakland, Calif.

TOPPING, CHARLES HINCHMAN (Assoc. M. '37; M. '46), Prin. Architectural and Civ. Engr., Eng. Dept., E. I. duPont de Nemours & Co., Wilmington 98, Del.

TRIAY, CHARLES ROLAND, JR. (Jun. '37; Assoc. M. '46), Civ. Eng. Associate, Los Angeles Dept. of Water and Power, 207 South Broadway, Room 826, Los Angeles, Calif.

WIGGINS, RALPH RAYMOND (Assoc. M. '09; M. '46), Chf. Engr., Colombian Petroleum Co., Apartado 100, Cucuta, Colombia.

ZUMWALT, PAUL LAWRENCE (Jun. '38; Assoc. M. '46), Hopedale, Ill.

RESIGNATIONS

DAHL, HARRY WALTER, Jun., resigned Aug. 4, 1946.

FORSTHOFF, JOSEPH ROBERT, Jun., resigned July 31, 1946.

REINECKE, PAUL SORG, M., resigned Aug. 14, 1946.

ROBERTS, ELBERT, Jun., resigned Aug. 20, 1946.

ZEITFUCHS EMIL ALBERT, Assoc. M., resigned Aug. 14, 1946.

REINSTATEMENTS

BISSCHOP, PHILIP ROWLAND ROOSEGAARDE, Assoc. M., reinstated Aug. 16, 1946.

FELT, HALL MERLE, Assoc. M., reinstated Aug. 12, 1946.

GROVE, EMERY CHESTER, Assoc. M., reinstated July 15, 1946.

SHAND, GADSDEN EDWARDS, M., reinstated Aug. 3, 1946.

WATFROD, TROY ELLIS, M., reinstated Aug. 6, 1946.

WHITE, FRANK EDWARD, Assoc. M., reinstated July 27, 1946.

WRIGHT, PURD B., JR., Assoc. M., reinstated July 15, 1946.

Applications for Admission or Transfer

OCTOBER 1, 1946 NUMBER 10

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every Member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid it in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board. Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years
Associate Member	Qualified to direct work	27 years	8 years	1 year
Junior	Qualified for subprofessional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to co-operate with engineers	35 years	12 years	5 years

APPLYING FOR MEMBER

AGE

ALLABACH, EARL PETER, Philadelphia, Pa. (46)
ALLAN, WILLIAM (Assoc. M.), Long Island City, N.Y. (43)
BARTZ, ALBERT WILLIAM, Allegheny, Pa. (49)
BELL, EDWARD ARTHUR (Assoc. M.), Essex Fells, N.J. (40)
BERRY, CARL MORRISON (Assoc. M.), Tacoma, Wash. (42)
CASSIDY, WILLIAM CLIFFORD, San Francisco, Calif. (38)
CHANDLER, SIDNEY WILLIAM (Assoc. M.), Jackson, Miss. (49)
COBB, JOHN CECIL, Charleston, W. Va. (45)
COCKROFT, WRIGHT SEMION, St. Paul, Minn. (54)
CORSER, CHAMP ELKINS (Assoc. M.), Bremerton, Wash. (39)
CUNDALL, KENNETH NEWTON, Alameda, Calif. (45)
DOUGHTY, SAMUEL CLIFFORD (Assoc. M.), New York City (39)
FRAMJI, KAVSI KAIKHOSROU, Paona, India (38)
FRANK, AARON HERBERT (Assoc. M.), Laurelton, N.Y. (49)
HOLTZ, WESLEY GORDON, Denver, Colo. (35)
JOHNSON, JOE WILLIAM (Assoc. M.), Berkeley, Calif. (38)
JOVENE, NICHOLAS ANGELO (Assoc. M.), Brooklyn, N.Y. (39)
KERN, LOUIS JOSEPH (Jun.), Elmhurst, N.Y. (36)
KOHLER, HAROLD, Buffalo, N.Y. (39)
LAWLOR, WALTER FRANCIS, St. Louis, Mo. (44)
LAZARD, RAYMAND, Paris, France (41)
LOVESEE, GEORGE WILLIAM, New York City (46)
MILFORD, THOMAS HENRY (Assoc. M.), Montgomery, Ala. (43)
MITCHELL, MANCE RANDOLPH, San Antonio, Tex. (44)
MURDICHIAN, KARMY KARNIG (Assoc. M.), Norfolk, Va. (39)
NEWMAN, JAMES BRYAN, JR., Washington, D.C. (50)
OLD, HOWARD NORMAN (Assoc. M.), Washington, D.C. (56)
PENNA, NICHOLAS CHARLES RICHARD (Assoc. M.), Harrison, N.Y. (42)
PICKETT, ARTHUR GORDON (Assoc. M.), San Mariono, Calif. (44)
PILON, CORWIN ALBERT, Longview, Wash. (40)
POORMAN, FRED SIMON, Washington, D.C. (45)
PRICHARD, ROBERT LEO (Assoc. M.), Chicago, Ill. (35)
PRITCHETT, JOHN WALLER (Assoc. M.), Austin, Tex. (64)
QUIRIN, EDWARD JOSEPH (Assoc. M.), New York City (35)
RADER, EARLE MORTON, Miami, Fla. (46)
RODAK, STANLEY WALTER, Pittsburgh, Pa. (43)
RUBINS, RALPH ESWARD (Jun.), San Francisco, Calif. (46)
SCHECKEL, WILLIAM BOULTON (Assoc. M.), Mountain Lakes, N.J. (51)
SCHILLER, HENRY MARTIN, Delmar, N.Y. (41)
STEPHENS, ROBERT BURTON, JR., Chicago, Ill. (45)
STUDLEY, ELBRIDGE GERRY, Los Angeles, Calif. (50)
TAYLOR, SAMUEL LE ROY, St. Paul, Minn. (57)
WARENDORFF, WALTER PAUL, Woodside, N.Y. (42)
WHITE, RUSSELL GRANT (Assoc. M.), San Antonio, Tex. (42)
WILLIAMS, JOHN JENKINS, Warren, Ohio (52)

APPLYING FOR ASSOCIATE MEMBER

AGE

BACKLOND, MAUNO OLIVER (Jun.), Chagrin Falls, Ohio (34)
BARLOW, GEORGE RILEY, San Gabriel, Calif. (35)
BENNETT, WILFORD S., Louisville, Ky. (39)
BIGELOW, HENRY WAITE, JR., Balboa Heights, C.Z. (39)
BIRDSEYE, WALTER HULL, Oklahoma City, Okla. (40)
BLAKE, ROBERT LOGAN (Jun.), Phoenix, Ariz. (32)
BOUQUARD, JOSEPH PETER, Chattanooga, Tenn. (29)
BRENDLE, RALPH C. (Jun.), Golden, Colo. (33)
BURKS, WILLIAM SPRATLEY, JR. (Jun.), Atlanta, Ga. (34)
BURNETT, RICHARD EDWARD, Escondido, Calif. (35)
BURNSON, BLAIR IRVING (Jun.), Oakland, Calif. (34)
CALLAHAN, JOSEPH CAL., Cincinnati, Ohio (36)
CALLEJAS, HIJO RAFAEL, Guatemala City, Gautemala, C.A. (36)
CHAPPELL, CARL JAMES (Jun.), Jefferson City, Mo. (35)
CHOWDRY, TEJBHAN, Bahawalpur, India (36)
COCHRANE, FRED DAVIS, Galveston, Tex. (36)
CRATER, DAVID HOPKINS (Jun.), Princeton, N.J. (3[illegible])
CRUME, FRANCIS PAUL, Houston, Tex. ([illegible])
CUMMINS, NEIL JOSEPH (Jun.), Bell, Calif. (36)
DAVID, THOMAS CHENEY, Alexander, La. (34)
DAVIS, JAMES WARREN (Jun.), Baltimore, Md. ([illegible])
DIKER, VEJDI RIFAT (Jun.), Ankara, Turkey (34)
DI LUZIO, FRANK, Santa Fe, N.Mex. (34)
DRAPER, ELMOND LLEWALLEN (Jun.), Albuquerque, N.Mex. (34)
ELDER, FRANCIS BEST, Madison, N.J. (40)
ERDLE, JOHN FRANCIS (Jun.), Anderson Dam, Idaho (35)
FADUM, RALPH EIGIL (Jun.), Lafayette, Ind. (35)
FENLON, HUGH FRANCIS, Pelham, N.Y. (3[illegible])
FOSTER, CHARLES BRADFORD, JR. (Jun.), Shreveport, La. (31)
FULLARTON, HUGH ALEXANDER, Washington, D.C. (38)
GARLAND, CHESLEY FISHER (Jun.), Jacksonville, Fla. (40)
GILMAN, ALLEN WAYNE, Harvey, Ill. (32)
HARRIS, LUCIAN JEFFERSON, JR., Birmingham, Ala. (30)
HASTINGS, DAVID CANFIELD (Jun.), Buffalo, N.Y. (31)
HORNE, CLEVELAND REID, JR. (Jun.), Quonset Point, R.I. (31)
HUNT, LAWRENCE HALLEY (Jun.), River Forest, Ill. (22)
JONES, SAMUEL CLAIBORN, Montgomery, Ala. (39)
KANTEY, BASIL AVRON, Ann Arbor, Mich. (28)
KUDIRKA, JOSEPH JOHN, Philadelphia, Pa. (30)
LEAVER, ROBERT EDMUND (Jun.), Seattle, Wash. (29)
LINGO, ROBERT MYRON (Jun.), Topeka, Kans. (32)
McCAFFREY, WILLIAM THEODORE (Jun.), Pensacola, Fla. (34)
MICK, KERWIN LEWIS, Minneapolis, Minn. (39)
MONTEALEGRE, FEDERICO JIMENEZ, San Jose, Costa Rica (33)
MORROW, WILLIAM THOMPSON, Marshall, Tex. (36)
NICHOLS, PAUL RAINEY, Crossville, Ala. (33)
PAXON, LYLE LAREN (Jun.), Greenville, S.C. (34)
PRENTICE, WILLARD JENISON, Baltimore, Md. (37)
PURI, KIDAR NATH, New Delhi, India (35)
RAPHAEL, JEROME MAURICE (Jun.), Denver, Colo. (35)
REINHARDT, CHARLES ORVILLE (Jun.), Champaign, Ill. (34)
REPPART, HOMER LEROY, Topeka, Kans. (43)
SHANNON, WILLIAM LOVEJOY (Jun.), Middlesex, Mass. (33)
SHOPE, JOHN GILBERT, Arlington, Va. (39)

Sohal, Kartarsingh, Bahawalpur, India (34)
Staggs, William Garnett, Corpus Christi, Tex. (40)
Teoart, Harold George, Los Angeles, Calif. (35)
Thompson, William Robert (Jun.), Newark, Ohio (33)
Tiller, James Hugh, Jr., Phoenix, Ariz. (35)
Voodhigula, Utai (formerly Oui Thieng) (Jun.), Bangkok, Siam (36)
Watson, Harry Raymond, Kansas City, Mo. (49)
Welch, Harold Joseph, Temple, Ga. (29)

APPLYING FOR JUNIOR

Age

Boehmig, Robert Laird, Pittsburgh, Pa. (27)
Carpenter, John Morton, Ames, Iowa (27)
Carr, Ralph Stevens, Jr., South Braintree, Mass. (28)
Cici, Guri Vasil, Wilmington, Del. (28)
Fogg, Robert Knowlton, Long Beach, Calif. (26)
Hodges, James Earl, San Diego, Calif. (25)
Hook, Walter Allen, Portland, Me. (29)
Hu, Chia-Tsun, New York City (28)
Jackson, Howard Nelson, Hales Corners, Wis. (31)
Meservey, Elmer Benson, Wollaston, Mass. (31)
Mirise, Kenneth Edward, Denver, Colo. (28)
Peznik, Richard Irving, New York City (26)
Quijano-Navas, Hernando, Bogota, Colombia (26)
Reeves, William Henry, Jr., Tallahassee, Fla. (26)
Reynolds, James, Jr., Tiburon, Calif. (30)
Stanford, Pat Harris, Midland, Tex. (23)
Tobachnik, Edgar Moore, Easton, Pa. (24)
Wolfe, Kenneth Gilbert, Berkeley, Calif. (26)
Wolff, George Edward, Avoca, Iowa (30)
Woolfolk, Robert Lee, III, Vicksburg, Miss. (30)

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Kylberg, Robert Cornelius (26)

MASS. INST. TECH.

Van Tevlingen, Arie Andrew (25)

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DREXEL INST. TECH.

Miller, Richard Harrison (25)

GEORGIA SCHOOL OF TECH.

Freedman, Joseph (23)
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UNIV. OF MINN.

Kapila, Indar Prakash (22)

UNIV. OF VERMONT

Tooles, Calvin Warren (25)

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Anderson, Gordon Cogswell (24)

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Kwinn, Edward Stanley (24)
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Walker, Jack Richard (20)

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Knoeber, George William (25)
Smith, Carl Linwood (22)
Smith, Donald Everett (20)
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Bachmann De Mello, Victor Froilano (20)
Tajirian, Faraj der Wahan (25)

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Burke, George Edward (24)
Hogan, Earl Micheal (29)

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Hiller, Kenneth (20)
Wolin, Martin (24)

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Seide, Paul (20)

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Matthews, Clarence Burton (27)
Pearson, Erman Alfred (26)
Rasmussen, William Elmer (25)
Rennord, Paul Andrew (28)
Stensrud, Donald Gilbert (22)

UNIV. OF WIS.

McCoy, William Daniel (21)
McVeigh, Raymond Joseph (24)

YALE UNIV.

Shurlds, Albert Maury (20)

The Board of Directors will consider the applications in this list not less than thirty days after the date of issue.

RECENT BOOKS

New books donated by the publishers and filed in the Engineering Societies Library, or in the Society's Reading Room. Notes regarding books are taken from the books themselves, edited by the staff of the Society or of the Library. Books in the Library may be borrowed by mail by Society members for a small handling charge.

Data Book for Civil Engineers, Vol. II. Specifications and costs. By E. E. Seelye. John Wiley & Sons, New York; Chapman and Hall, London, 1946. 325 pp., diagrs., charts, tables, 12 × 9¼ in., fabrikoid, $6.75. Under the following headings this volume presents typical specifications to serve as a guide for the practicing engineer: Structural specifications, airports, roads, railroads, bridges, docks, dams, drainage, sewers, sewage treatment, and water. Section VIII, on costs, provides the engineer with a framework of relative costs of materials, equipment, and labor, and by relating these costs to the *Engineering News-Record* cost indexes, as indicated, effective working figures may be realized. A 70-page, classified glossary concludes the book. Volume I of the series presented a comprehensive collection of design data; Volume III will cover field practice.

Engineering Mechanics, 2 ed. By S. Fairman and C. S. Cutshall. John Wiley & Sons, New York; Chapman & Hall, London, 1946. 267 pp., diagrs., tables, 9¼ × 5¾ in., cloth, $3. The object of this book is to provide a self-contained course in fundamental mechanics, which can readily be covered in the usual time allotted to the subject. A knowledge of calculus and general physics is assumed, and no attempt is made to include material which may properly be deferred to courses in advanced strength of materials. Special attention has been paid to arranging the subject matter in the most logical and effective order within the two main sections—statics and kinetics.

Great Britain. Dept. of Scientific and Industrial Research. Atmospheric Pollution Research. Technical Paper No. 1. Atmospheric Pollution in Leicester. His Majesty's Stationery Office, London, 1945. 164 pp., illus., diagrs., charts, tables, 9½ × 6 in., cloth, 3s. (Obtainable from British Information Services, 30 Rockefeller Plaza, New York, 95 cents.) As a part of the program of research on atmospheric pollution of large towns, some 200,000 readings of gages, filters, and other apparatus were taken over a three-year period. The apparatus used is described with methods for accurate determinations. The results are summarized and discussed, and the practical aspects are emphasized with suggestions on smoke abatement, sulfur control, and town planning.

(The) Postwar Development of Road Motor Transport. By H. E. Aldington, E. G. Beaumont, and J. S. Nicholl. Institution of Automobile Engineers, London, S.W.1. (12 Hobart Place), 1945. Pp. 179–210, illus., tables, 8½ × 5½ in., paper, 1s, 6d. This small pamphlet presents three papers read at a joint meeting of eight British technical societies and covers the following topics: Roads (highway design and traffic development); progress of motor vehicle design and construction; traffic analysis and planning.

Steam Power Plant Auxiliaries and Accessories, 2 ed. By T. Croft, Editor; revised by D. J. Duffin. McGraw-Hill Book Company, New York and London, 1946. 583 pp., illus., diagrs., charts, tables, 8¼ × 5½ in., cloth, $5. A practical manual for the operating engineer, this book has been revised to conform with the changes that have taken place in the 24 years since it was originally published. Topics on which considerable new material has been added include reciprocating and centrifugal pumps, methods of boiler feeding, feedwater heaters, economizers and air preheaters, condensers, steam piping of power plants, and steam traps. As before, there are review questions and problems and a technical data section has been added.

Zürich, Eidgenössische Technische Hochschule. Institut für Baustatik. Mitteilungen. Nr. 15. Vorgespannter Beton by M. Ritter and P. Lardy. 118 pp., 12 Sw. frs. Nr. 16. Die Berechnung der Stockwerkrahmen by R. Ulrich. 123 pp., 9 Sw. frs. Leemann & Co., Zürich, Switzerland, 1946. illus., diagrs., charts, tables, 9 × 6 in., paper. These are two new publications from the Swiss Institute of Structural Statics. No. 15 covers the theory and calculations of pre-stressed concrete with regulations for its use and practical examples. There is a brief bibliography. No. 16 is concerned with analysis and calculations for the framing of multi-story steel buildings under various conditions.

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8 W. 40th St.	211 W. Wacker Dr.	100 Farnsworth Ave.	57 Post St.

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A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription of $3 per quarter or $10 per annum, payable in advance.

Men Available

Civil Engineer; Assoc. M. ASCE; 51; B.S.C.E.; licensed C.E.; 26 years' experience on engineering projects, covering the design and construction of railroad facilities, bridges, roads, schools, hospitals, auditoriums, water and sewerage projects. Desire permanent position as office or executive engineer with engineering firm or contractor. Available in 30 days. C-308.

Project Manager or Superintendent; M. ASCE; licensed C.E. and land surveyor; age 50; 25 years' broad experience in heavy construction; overall management of projects and their planning; highways, water supply, drainage, irrigation, railroads, bridges, port facilities; large surveys and highway locations. Considerable work in foreign countries. Speak Spanish and French. Understand Portuguese. C-309.

Engineer; Jun. ASCE; 27; married; graduate of Carnegie Institute of Technology; major, U.S. Corps of Engineers—4 years' experience on general construction work as operations and planning officer; 2 years' experience in supervisory capacity on railroad maintenance of way; can meet and get along with men in all positions; desire permanent position in Pittsburgh area. C-310.

Civil Engineer, Assoc. M. ASCE; married; 24 years' experience on design, construction, maintenance, and operation, principally railroad work. Proved executive ability. Will go anywhere in continental United States. At present engaged as chief engineering officer for medium-sized plant. Looking for greater opportunity and outlet for ability. Best of references. C-311-C2634.

Civil Engineer, M. ASCE; 48; graduate; licensed; 22 years' experience on highway and railroad bridges—8 years on design of reinforced concrete and steel bridges, and 14 years on inspection (mostly supervisory) of materials and fabrication for largest bridges in country. Experienced in examination of large existing bridges, reports. At present in consulting engineer's office. Desire connection of supervisory nature on bridge work in field or office. C-312.

Assistant Professor of Civil Engineering; Assoc. M. ASCE; seeks connection with college in Metropolitan Area. Subjects: Structures, reinforced concrete, mechanics, calculus, hydraulics. Have had over 20 papers published. Past 4 years on highly technical, confidential work for U.S. Army, involving design of ammunition bases. No objection to freshman subjects. C-313.

Civil Engineer; Jun. ASCE; 28; married; B.S.C.E., Univ. of Washington, 1940; 6½ years' experience as instrumentman and assistant engineer in engineering department of large Midwestern railroad. Desire position with small or medium-sized consulting engineering firm operating west of the Mississippi. C-314-C3054.

Civil Engineer; Jun. ASCE; 31; licensed professional engineer, New York; graduate; discharged captain, Sanitary Corps, A.U.S.; 10 years' varied experience in planning, design, and construction of water works, sewerage, flood control work, highway, industrial and domestic buildings. Desire connection with consulting or construction firm in New York area or Washington, D.C. C-315.

Civil Engineer; Jun. ASCE; 31; married; licensed professional civil engineer; licensed airplane pilot; assistant chief engineer in charge of new projects to $500,000 from original surveys through design, specifications, estimates, advertising and letting of contracts, construction inspection, to final acceptance tests, for statewide organization. Desire similar position with larger organization. C-316.

Construction Engineer; Assoc. M. ASCE; 42; 20 years' experience on location, design, and construction of highways, dams, navigation locks, airfields. Experience includes extensive materials research and administration of engineer organizations up to 1,000 men in the United States and South America. Speak Spanish. Available for executive position with contracting or engineering firm. C-317.

Positions Available

Draftsman and Detailers. (*a*) Concrete Detail Draftsman to prepare drawings and check drawings of other draftsmen, on concrete girder spans, concrete pile bents, concrete piers, and concrete deck slabs of various steel spans. (*b*) Steel Detailers, preferably with experience in preparation of detail drawings for steel plate girders and steel trusses. Fabrication shop experience desirable. Salaries, $3,600–$3,900 a year. Temporary. Location, Florida. W-7681.

Instructor or Assistant Professors, two. (*a*) One graduate civil engineer, young, to teach plane surveying to a group of sophomore students, a course in highways, water supply, and sewage disposal to group of senior civil engineering students, and possibly strength of materials and hydraulics. (*b*) One to teach applied mechanics. Salaries, $2,000–$4,500 for nine months. Location, Texas. W-7697.

Designer, with sewage treatment experience, to prepare specifications, detail, and lay out piping and general concrete construction. Salary, $4,200–$4,800 a year. Location, Pennsylvania. W-7711.

Engineers, with some experience in planning and designing water transmission and distribution systems; ground-water supply works; water purification and softening plants; and electric, steam, and internal combustion engine pumping stations, to aid in development, specification, and preparation of water-works system. Location, Florida. W-7716.

Architectural Draftsman, who has had 5 to 10 years' experience, for building construction and alteration work, both interior and exterior. Permanent position with large department store. Salary, about $3,900 a year to start. Location, South. W-7750.

Civil Engineers, single with 3 to 5 years' field experience, to assist construction foreman; inspect materials and make layouts on oil field construction. Knowledge of Spanish desirable. Salary, $3,600–$4,800 a year plus living allowance. Location, Venezuela. W-7763.

General Construction Superintendent for engineering contracting organization for operation in foreign and domestic fields. Will be required to take charge of large refinery projects and processes. Must have well-rounded construction experience. Must be good organizer, be able to handle labor, and have executive ability. Compensation commensurate with ability. Apply by letter giving full details of education, ex-

perience, salary required, etc. Headquarters, Middle West. W-7768.

ENGINEERS with water-works design experience. (*a*) Civil Engineers, graduates, to design and detail concrete structures. (*b*) Civil Engineers, recent graduates, with some mapping experience, to assist in topographic survey. Location, foreign. W-7774.

SUPERINTENDENTS AND FIELD ENGINEERS, single, with sound background in construction for the following fields: residential housing construction, major building construction, steel erection, tank and pipe-line construction. Working knowledge of Spanish desirable. Salaries, \$4,800-\$6,600 a year plus living expenses. Location, Venezuela. W-7796.

ENGINEER, young, experienced in hydraulic design studies, computation, and supervision of small and medium-sized projects. Salary open. Headquarters, Pennsylvania, with part of time spent in Central America. W-7804.

PROFESSORS AND INSTRUCTORS. (*a*) Professors of Civil Engineering in the following fields: Hydraulics, highway engineering, and structural engineering. Salary, from \$4,200 for nine months, depending upon qualifications. (*b*) Instructors. Salary, \$2,250 for nine months. Location, Texas. W-7815.

STRUCTURAL STEEL ENGINEER to design and detail industrial buildings, equipment supports, etc., for process engineering concern. Salary, \$3,650 a year. Location, Connecticut. W-7827.

INSTRUCTOR OR ASSISTANT PROFESSOR of civil engineering, to teach course in soil mechanics, geology, and surveying. Position available October 1946. Location, Massachusetts. W-7706.

STRUCTURAL DESIGNERS AND DETAILERS for a depressed urban-type expressway and a major program of parkway and highway bridges, and railroad and highway-grade separations. Structures include rigid frame, continuous and simple spans in steel and reinforced concrete. Salaries, \$2,580-\$4,140 a year, 40-hour week plus overtime. Write giving age, education, experience, references, snapshot, sample of drafting, and other data available. Location, Michigan. D-2999.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in this Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article, from your own file, from your local library, or direct from the publisher, or they may be borrowed from the Engineering Societies Library. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

BASCULE. L'équilibrage des ponts mobiles du type Scherzer, M. Silhol. *Annales des Ponts et Chaussées*, vol. 115, no. 5, Sept.-Oct., 1945, pp. 539-552. Counterpoising of bascule bridges of Scherzer type; principle and design of Scherzer bridge; study of movement of working parts; center of gravity; modifications required for obtaining correct equilibrium; example given.

CONCRETE ARCH, SWITZERLAND. Furstenland Bridge, Switzerland. *Engineer*, vol. 181, no. 4704, Mar. 8, 1947, p. 227. Illustrated description of concrete-arch bridge on road between St. Gall and Zurich, built to replace old stone viaduct; arch has span of 442 ft; concrete used in construction was vibrated in place.

CONCRETE, MAINTENANCE AND REPAIR. Il ripristino di un ponte danneggiato da operazioni belliche, C. C. Guidi. *Giornale del Genio Civile*, vol. 83, no. 2, March-April 1945, pp. 119-126. Illustrated description of reconstruction of railroad bridge, Rome-Civitacastellana-Viterbo, Italy, damaged by bombs during the war; temporary and permanent structure; permanent structure is combined truss and plate structure of reinforced concrete; data on pile foundation and loading test included.

CONCRETE, NEW ZEALAND. Railway Bridges of Reinforced Concrete, C. W. O. Turner. *New Zealand Instn. Engrs.—Proc.*, vol. 31, 1945, pp. 307-344 (discussion) 344-350 (supp. plates) 351-360. Illustrated description of railroad bridges Westport-Inangahua, South Island Main Trunk, and Wairoa-Gisborne railway, New Zealand; bridges are of reinforced concrete of girder type, both simple and continuous spans being used; costs of concrete and steel bridges are compared; stress analysis for Aniseed Creek Bridge presented in full detail.

CONCRETE, PREFABRICATED. Southern Ry. Builds Its First Precast Bridge. *Eng. News Rec.*, vol. 136, no. 16, Apr. 18, 1946, pp. 540-541. Illustrated description of new double-track railroad bridge across Haw River near Reidsville, N.C.; bridge consists of four lines of pre-cast deck slabs supported on six-pole bents built of pre-cast piles 24 in. in diameter; details of construction work.

CONCRETE, PRE-STRESSED. Prestressed Concrete Footbridge. *Concrete & Constr. Eng.*, vol. 41, no. 5, May 1946, pp. 139-140. Brief description of footbridge over tracks at Bully-Grenay, station of French National Railways; each of two, approximately 100-ft, spans comprises two prestressed concrete girders connected by deck slab; saving in weight of steel was about 60% compared with ordinary concrete.

CONCRETE SLAB. Four Span Flat Slab Bridges, A. W. Hill. *Surveyor*, vol. 105, nos. 2833, 2836, May 10, 1946, pp. 367-369, May 31, pp. 427-429. Computation of four-span slab bridge of reinforced concrete with equal spans and uniform section; general formulas are developed for uniform load and point loads, and applied to numerical examples, one of them with equal end spans but less than two central spans.

CONSTRUCTION, MILITARY ENGINEERING. Bridge Building by Canadian Army Engineers in Europe, C. A. Campbell. *Roads & Bridges*, vol. 84, no. 3, Mar. 1946, pp. 117-118, 160-161, 163, 165-166. Illustrated description of rebridging Po River in North Italy, including soil conditions, superstructure, piers, etc.; in addition, construction of Rhine bridges is described; latter were constructed by using Bailey bridging with pile-driving rigs, rigged in cantilever fashion.

FLOORS. Bridge Deck Modernized. *Roads & Streets*, vol. 89, no. 4, Apr. 1946, pp. 94-96. Illustrated description of repairs to approaches and deck of Anthony Wayne Bridge at Toledo, Ohio; repairs included construction of median strip to create four-lane divided highway, placing of $2^1/_4$-in. asphaltic concrete surface, and reconstruction of expansion joints.

FLOORS. Bridge Floor Strengthened by Arc-Welded Spiral Rods. *Construction Methods*, vol. 28, no. 5, May 1946, pp. 90-92, and 172. Bridge at Scranton (Pa.), comprising 6 Pratt through-truss spans and 1 deck span, was strengthened to carry 15-ton truck loads and eliminate vibration; reinforcement consisted of spiral bars and transverse and longitudinal bars to be embedded in concrete roadway slab 6 in. thick; details presented in illustrations; breakdown of cost included.

RAILROAD, MAINTENANCE AND REPAIR. Reconstructing Bridge Under Wartime Traffic, J. D. Jacobs. *Compressed Air Mag.*, vol. 51, no. 6, June 1946, pp. 153-159. Brief historical review of New York Central Sandusky (Ohio) Bay Bridge consisting of 5 trestle-constructed sections, also factors pertaining to extensive maintenance required; detailed description of modern rebuilt structure on concrete-filled steel piers, construction methods, traffic movement, specifications, air equipment employed for drilling, etc.

SUSPENSION, FAILURE. Model Tests of Tacoma Bridge. *Western Construction News*, vol. 21, no. 5, May 1946, pp. 94-98. Study of causes of collapse of Tacoma Bridge and of measures to prevent such failures, ordered by Washington Toll Bridge Authority; tests on 100 scale model shed light on problem and led to certain new principles of structure of suspension bridges; illustrated description of tests and report on findings.

BUILDINGS

CONCRETE, PREFABRICATED. Factory Constructed with Precast Units. *Concrete & Constr. Eng.*, vol. 41, no. 5, May 1946, pp. 140-142. Illustrated description of single-story factory building, 300 ft long by 48 ft wide, constructed almost entirely of prefabricated concrete units; technical details included.

HEATING, RADIANT. Radiant Heating for Modern Construction, C. A. Hawk, Jr. *Power*, vol. 90, no. 5, May 1946, pp. 307-309. Practical pointers are given on installation of radiant heating equipment with example of typical design for hospital system; discussion also touches on embedding pipes in concrete floors, use of continuous coil or grid design, controlling flow, fabrication of pipe into coils, and control of radiant heat system.

HOUSES, PREFABRICATED. Prefabrication from Architectural Point of View, N. Tweddell. *Surveyor*, vol. 105, no. 2838, June 14, 1946, p. 472. Definition is given of prefabrication; in fact, there are only degrees of prefabrication; nearest approach is "Airoh" house which is transported in four sections and bolted together on site; discussion of site erection and labor, speed, and cost. Before Roy. Sanitary Inst. Congress.

STEEL, INSPECTION. Inspection of Steel Frame Building Under Erection, H. J. Nash. *Eng. Inspection*, vol. 10, no. 2, Summer 1945, pp. 21-25. Mill, shop, and site or field inspection, with particular reference to British practices; duties of inspector in mill; importance of knowledge of structural drawings and of riveting; inspection of welding; problems in shop and at erection site; storage of materials; correction of stanchions; examination of grillages; adjustment of beams; packing between stanchions.

STRUCTURAL STEEL. Steel in Modern Building Construction, C. F. Block. *Steel*, vol. 119, no. 2, July 8, 1946, pp. 98-101, 127, and 130. Factors concerning design, insulation, and installation of light-weight steel sections for both commercial and residential building construction; various applications illustrated and described, including data on durability, corrosion resistance, attractiveness, and steel codes and standards developed in this field.

WAREHOUSES. Steel Frame Erected in Record Time, R. Gauthier. *Western Construction News*, vol. 21, no. 5, May 1946, pp. 100-101. Four-acre warehouse of riveted steel frames was raised in seventeen days; illustrated report on construction.

CITY AND REGIONAL PLANNING

GREAT BRITAIN. Density and Planning, W. P. Haldane. *Surveyor*, vol. 105, no. 2838, June 14, 1946, pp. 467-469. Discussion of density in recent history of London, Liverpool, Birmingham, Manchester, and Plymouth; data on residential, recreational, industrial, and commercial densities; advantages and disadvantages of low-density housing; suitable standards for housing densities. Before Instn. Mun. & County Engrs.

CIVIL ENGINEERING

PLASTICS. Use of Plastics in Civil Engineering, E. S. Childs. *Boston Soc. Civ. Engrs.—J.*, vol. 33, no. 2, Apr. 1946, pp. 82-101. Discussion of use of plastics in various fields of civil engineering, including data on general characteristics, phenolics, bakelite, vinyl plastics (to replace rubber as insulation), chemical resistance, compression, injection, and extrusion molding, color, laminated plastics, impact tests, and plastic impregnated plywood.

CONCRETE

Beams and Girders. Vertical and Inclined Stirrups, A. J. Ashdown. *Concrete & Constr. Eng.*, vol. 41, no. 6, June 1946, pp. 155–158. It is suggested that middle third of span of reinforced concrete beams be provided with vertical, and remaining length with inclined stirrups; suggestion is based on theoretical study.

Drydocks, Australia. Graving Dock Lined with Shotcrete, W. H. R. Nimmo. *Eng. News-Rec.*, vol. 136, no. 14, Apr. 4, 1946, pp. 481–483. Illustrated description of graving dock at Brisbane, Australia; wartime scarcity of men and equipment necessitated improvisations; impervious sandstone with sprayed-on layer of shotcrete ranging from 1/4 to 1/2 in., which simplified in lining requirements; pumping plant was assembled largely from salvaged equipment.

Houses. Concrete Houses—Current Construction Practice, W. V. Myer. *Concrete*, vol. 54, nos. 5 and 6, May 1946, pp. 10–12, and 32; June, pp. 10–13. Illustrated description of "plastic rock" house; data on type of construction, casting concrete frame 4 × 4 in. around steel sash window frames, pouring concrete on site, and tilting up walls; houses reported to be successful structurally and commercially; illustrated description of concrete houses devised by R. G. LeTourneau.

Mixing. Proportioning of Concrete, A. T. Goldbeck. *Concrete*, vol. 54, no. 5, May 1946, pp. 18–20, 26, and 30. Development of method for determining concrete proportions to insure, with little change, desired consistency and workability in field mix; method is based on laboratory tests; numerical example of proportioning of structural concrete shows practical application of method.

Mixing, Moisture Control. Maintain Close Control on Moisture Content. *Rock Products*, vol. 49, no. 4, Mar. 1946, pp. 80–81, and 83. Illustrated description of moisture control system in ready-mixed concrete plant; percentage of moisture is indicated on special Toledo dial scale; method requires no special laboratory technique to manipulate.

Pavement, Maintenance. Maintenance and Repair of Portland Cement Concrete Pavement, A. A. Anderson. *Am. Concrete Inst.—J.*, vol. 17, no. 5, Apr. 1946, pp. 477–492. Discussion of routine maintenance operations, such as sealing cracks and joints against infiltration, patching, "mud-jacking," pumping of slabs, protective treatment of surface scale where air-entraining portland cement was not used, etc.; illustrations presenting some types of repair included.

Products. Fifty Years of Concrete Products, B. N. Nordberg. *Rock Products*, vol. 49, no. 6, June 1946, pp. 163–167, 172–174. Review of developments in concrete products industry; illustrated description of hand-tamped blocks, concrete bath tubs and pre-stressed units, concrete pipes, various wall systems, concrete burial vaults, machinery developments, exhibits, decorative facings, and light-weight aggregates.

Railroad Ties. Prestressed Concrete Sleepers. *Concrete & Constr. Eng.*, vol. 41, no. 6, June 1946, pp. 168–170. New method of manufacturing pre-stressed concrete ties in Great Britain is described; all movements of molds, ties, and materials within factory are mechanically controlled.

Reinforcement. Le frettage du béton, P. Delpeuch. *Annales des Ponts et Chaussées*, vol. 115, no. 5, Sept.-Oct. 1945, pp. 553–570. Study of spiral reinforcement of concrete, considering elastic and plastic deformations, tension and adherence of reinforcement; determination of strength of spirally reinforced concrete with aid of new formulas that take into consideration actual pressure of spiral reinforcement; comparison of results obtained from old and new method.

Reinforcement. Relation of Reinforcement to Modern Reinforced Concrete Theories, C. E. Reynolds. *Junior Instn. Engrs.—J.*, vol. 56, pt. 6, Mar. 1946, pp. 147–164. Types of reinforcement currently employed in Great Britain, and development of design theory leading to improved concrete reinforcement; classification of materials employed; comparison of conventional theory and plastic theory as means of assessing value of reinforcement in augmenting concrete resistance; safe concentrated column loads. Bibliography.

Reinforcement, Corrosion. Electrolysis of Steel in Concrete. *Engineer*, vol. 181, no. 4703, Mar. 1, 1946, p. 205. Report of work carried out by electrical section of American Association of Railroads; tests consisted of measuring current flow and noting corrosive effects on 1-in. round iron-rod specimens placed in ground and subjected to d-c potential of 25 v to ground; specimens were encased in circular concrete forms; examination also made of concrete catenary foundation on Illinois Central.

Reservoirs. Ancien et nouveau réservoir de la Côte-des-Neiges, A. Brisset. *Revue Trimestrielle Canadienne*, vol. 32, no. 125, Spring 1946, pp. 60–74. Illustrated description of old and new reservoir of water works in Montreal; purpose is to assure sufficient water reserve at constant pressure; it obtains water through concrete pipes with aid of pumps; capacity of new

reservoir is 7½ million imp gal with possibility of increase up to 15 million; walls, floor, and roof are of reinforced concrete.

RETAINING WALLS. Offset Retaining Walls for Stockpiles, H. M. Hadley. *Eng. News-Rec.*, vol. 136, no. 14, Apr. 4, 1946, pp. 497–498. Illustrated description of reinforced concrete retaining walls to separate adjoining stockpiles of sand and gravel of various sizes; details of structure presented in illustrations.

ROADS AND STREETS. Concrete Pavement Design, H. F. Clemmer. *Roads & Bridges*, vol. 84, no. 4, Apr. 1946, pp. 73–75, 126, 128, 130, 132, 134, and 136. Illustrated discussion covering subgrades, effect of aggregate and of volume changes, sealing of joints, load transfer reinforcement, strength of slab, air-entraining cement, curing, etc.; graphs showing actual movement of concrete joints; effect of calcium chloride on compressive strength; comparison of resistance to abrasion of concrete cured under different conditions. Before Can. Good Roads Assn., Quebec.

ROADS AND STREETS. High Early Strength Concrete for Utility Openings and Other Repairs in Cement Concrete Pavements, F. D. Woodruff. *Pub. Works*, vol. 77, no. 5, May 1946, pp. 19–21, 38–39. Directions are given in detail for repair of openings in concrete surfaces, where speed of repair is essential; data on materials, preparation of subgrade, and of concrete mixing and placing; high early strength concrete should be used.

ROADS AND STREETS. Longitudinal Cracking in Concrete Pavements, B. C. Sutherland. *Pub. Roads*, vol. 24, no. 8, Apr.-May-June, 1946, pp. 207–219. Study of causes of longitudinal cracks in concrete roads, made by State Highway Departments of Kentucky, Indiana, and Illinois, including design data, subgrade and drainage conditions, and crack survey; delay in fracturing center joint is important cause of cracking; definite separation at center joint at time of construction found necessary.

ROOFS. Arch Roof in Pre-stressed Concrete, R. B. Shama. *Concrete & Constr. Eng.*, vol. 41, no. 4, Apr. 1946, pp. 112–115. Illustrated description of concrete shell roof built in India with prestressed concrete arches 120 ft by 35 ft; structure is statistically determinate; discussion of procedure of pre-stressing including data on stresses.

WALLS. Report of tests on Reinforced Concrete Masonry, F. J. Converse. *Bldg. Standards Monthly*, vol. 15, no. 2, Feb. 1946, pp. 4–11. Tests described were made to determine effectiveness of reinforced concrete walls in resisting lateral flexural forces and longitudinal shearing forces, selection of materials, construction methods used, and procedures followed, were designed to result in wall sections of quality approximating that readily produced in field.

WAREHOUSES. Precast Structural Members Facilitate Speedy Erection of Rigid-Frame Building, W. M. Angas. *Eng. News-Rec.*, vol. 136, no. 16, Apr. 18, 1936, pp. 546–548. Pre-cast concrete roof slabs and hollow-box rigid frames made rapid erection of two, one-story warehouses at Mechanicsburg, Pa., possible at relatively low cost; details of structure and assembly methods.

DAMS

EARTH, MAINTENANCE AND REPAIR. Leakage of Clay Core-Wall, A. W. Bishop. *Surveyor*, vol. 105, no. 2832, May 3, 1946, pp. 343–346. Illustrated report on leakage of earth embankment of Lee Valley dam of London water supply; investigations revealed that clay core wall of embankment shrank and cracked when, at beginning of war, water level was lowered as precautionary measure; importance of maintenance of conditions favorable to this type of dam and of use of clay with low potential shrinkage is stressed. Bibliography.

EARTH, MAINTENANCE AND REPAIR. Leakage of Clay Core Wall, A. W. Bishop. *Water & Water Eng.*, vol. 49, no. 604, Midsummer 1946, pp. 349–357, 359–366. Previously indexed from *Surveyor*, May 3, 1946.

EARTH, SOUTH CAROLINA. Saluda Dam Reinforced, A. W. Reid. *Eng. News-Rec.*, vol. 136, no. 14, Apr. 4, 1946, pp. 470–474. Illustrated description of reinforcement of Saluda Dam near Columbia, S.C., comprising design studies, extension of drainage system, alterations of power house, and installation of rock blanket on downstream slope by placing more than half a million cubic yards of rock on dam in 10-ft terraces.

GEOLOGY. Pleistocene Deposits of Shipshaw Area, Quebec, R. F. Legget. *Roy. Soc. Canada—Trans.*, vol. 39, sec. 4, May 1945, pp. 27–39, 2 supp. plates. Notes based on subsurface investigations prior to construction of Shipshaw power development, in which 1,200,000 hp is generated by flow of Saguenay River under head of 212 ft; technical descriptions of project itself were indexed in *Engineering Index*, 1944, p. 881.

FLOOD CONTROL

IRAQ. Habbaniya Flood Relief Scheme. *Engineer*, vol. 181, no. 4711, Apr. 26, 1946, pp. 379–381, figs, p. 378. Scheme comprises construction of Ramadi inlet channel and regulator, and Mujarah escape channel and regulator, together with dikes and other subsidiary works.

regulator is 94 m wide between abutments; it is to have twelve 6-m openings provided with sluice gates working in grooves set in masonry of piers.

LEVEES. Closing Breaks in Tidal Levees, W. Q. Wright. *Eng. News Rec.*, vol. 136, no. 14, Apr. 4, 1946, pp. 477–480. New method of closing breaks in levees on tidal rivers developed by author; reversing tidal flow through break is employed to build up shoals that reduce opening and simplify closure.

LEVEES, REPAIR. Closing Breaches in Walcheren Dykes, P. Jansen. *Engineer*, vol. 181, nos. 4705, 4706, and 4707, Mar. 15, 1946, pp. 249–250; Mar. 22, pp. 263–266; Mar. 29, pp. 286–288. Illustrated description of damage by RAF bombing of dikes and ensuing inundation; methods of repair employed by Dutch engineers; problems of closing breaches; inundated area, measuring 40,000 acres in all, was effectively divided by canal banks from Flushing via Middleburg to Veere; various components of "Mulberry" harbor could be used advantageously for saving of Walcheren.

FOUNDATIONS

PILE. Column Strength of Long Piles of Steel, Timbers, Cast-Iron and Reinforced Concrete, G. P. Manning. *Civ. Eng.* (London), vol. 41, no. 478, Apr. 1946, pp. 145–148, and 150. Development of method for determining loading capacity of long piles on basis of conception of bent column; formula is similar to Euler formula; theory is applied to numerical example concerning hollow cast-iron cylinder and reinforced concrete pile.

ROCK DRILLS. Wagon Drills Mounted on Trucks as Jumbos. *Eng. News-Rec.*, vol. 136, no. 14, Apr. 4, 1946, pp. 475–476. Description of wagon drill in use for excavating 650,000 cu yd of rock in enlargement of spillway at Saluda Dam, S.C.; procedure of work presented in illustrations.

SOILS, CONSOLIDATION. Soil Consolidation by Electrolysis, F. L. Kassel. *Civ. Eng.* (London), vol. 41, no. 479, May 1946, pp. 187–188. Brief description of method of treatment of clay soils by means of electrolytical consolidation; moisture content and compressibility considerably reduced. Bibliography.

HYDRAULIC ENGINEERING

BREAKWATERS. Pressure of Breaking Waves, R. R. Minikin. *Dock & Harbour Authority*, vol. 26, no. 305, Mar. 1946, pp. 262–266. General considerations with reference to erection of permanent breakwaters; author has accepted theory of Brigadier Bagnold of internal mechanism of breaking wave and dovetailed it into results of full-scale experiments and observations of acknowledged authorities; expression for maximum total pressure of breaking wave against obstruction is given in terms which assist engineer to proportion profile of proposed breakwater.

PUMPS, CHARTS. Power Required to Overcome 100 Lineal Feet of Pipe Friction, B. Maddock. *Power Plant Eng.*, vol. 50, no. 3, Mar. 1946, p. 116. Power loss chart is presented, showing pumping horsepower needed to overcome 100 l in. ft of pipe friction, through various sizes of pipes and for various rates of flow expressed in gal per min.

HYDROELECTRIC POWER PLANTS

CHINA. China Plans Huge Hydroelectric Plant. *Concrete*, vol. 54, no. 6, June 1946, pp. 16–18; see also *Western Construction News*, vol. 21, no. 3, Mar. 1946, pp. 110–111. Brief illustrated description of irrigation, hydroelectric, and navigation development of Yangtze Valley, China.

OREGON. Seven Years' Operating Experience at Bonneville Hydroelectric Plant. *Power*, vol. 90, no. 3, Mar. 1946, pp. 146–150. Article tells how 724,000-hp capacity is regulated during floods and low water for maximum power, how pitting of runner blades from cavitation is repaired with stainless steel welding, and how large salmon runs are handled over dam in fishways; plant's ten Kaplan turbines and ten associated generators deliver power through transformers to 2,700-mile 115-v and 230-v transmission network.

INLAND WATERWAYS

RIVERS, DISCHARGE. Measurement of Discharges of River-basins of White Nile (Sudan) and Nene (Great Britain), R. F. Wileman and H. W. Clark. *Instn. Civ. Engrs.—J.*, vol. 26, no. 6, Apr. 1946 pp. 267–296, (discussion) 296–325, 2 supp. plates. Illustrated report on measurement of discharges; data on methods employed, standards set for survey, and gaging stations, discharge measurement over broad-crested weirs; current meters, reduction coefficients, and office work involved in production and maintenance of records.

IRRIGATION

APRONS. Percolation Under Aprons of Irrigation Works, S. L. Bey. *Engineer*, vol. 181, nos. 4709, 4710, and 4711, Apr. 12, 1946, pp. 328–330; Apr. 19, pp. 352–353, Apr. 26, pp. 375–377. Brief summary of investigations referring to filtering under aprons, largely based on lectures delivered at Engineering Faculty of Fouad-el-Awal University; original text modified to cover additional information, but basic conclusions reached at time are not affected by anything that occurred in interim.

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946, pp. 249-
pp. 286-288.
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Piles of Steel,
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Description of
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Saluda Dam,
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–188. Brief
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